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WOODEN MULTISTORY CONSTRUCTION IN FINLAND: PERCEPTIONS OF MUNICIPALITY CIVIL SERVANTS

Pro Gradu Thesis
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Tiivistelmä Referat – Abstract

For the last 20 years, the state administration of Finland has supported the development of wooden multistory construction (WMC) into the residential housing market. While the number of WMC dwellings has increased, WMC is still not a normalized construction practice. Civil servants—who are responsible for complying with national strategies while being tasked to satisfy the needs of Finnish citizens—are legally entrusted to oversee and approve the planning of all zoning maps. This authority includes the power to compel builders to comply with material preferences through zoning regulations. Regardless of this gatekeeping authority, they rarely enact such regulations.

This qualitative study examines the attitudes and perceptions of civil servants regarding WMC. It also examines the civil servants' interpretation of other stakeholder opinions towards WMC. The aim was to set a precedent for current-day beliefs about WMC from the perspective of this authoritative group, given no such in-depth opinions currently exist in the literature. Semi-structured interviews were held between May 2017-January 2018. 11 civil -servants holding high-level administrative roles in city planning and development from six different municipalities were interviewed.

Based on qualitative content analysis of the data, interviewed civil servants held a variety of attitudes towards WMC. Support for the implementation of WMC was due to benefits incurred by the positive qualities of the engineered wood products, which permit flexible construction technologies that directly enhance citizen lifestyles, while supporting local and national economies. Hindrances in the implementation of WMC were a result of an operating environment with poor information distribution, few WMC industry actors and limited government policy measures to support project implementation. These factors trigger high risk and high cost. Material limitations were rarely discussed, but may result in high cost or project risk. The stakeholders whose opinions were most frequently discussed included the municipalities the civil servants represented, municipality residents, and private developers. The opinions of other stakeholders (e.g. end users) were rarely mentioned. Developers are reluctant to take on WMC projects due to bottom-line mentality and perceived development risk. Residents' opinions are equally colored with interest and skepticism. Municipality opinions were mostly in line with the perceptions shared by civil servants. All stakeholders were perceived to have greater interest in WMC if risk or prejudice were dispelled through positive, real-world experiences or exposure to WMC.

Avainsanat – Nyckelord – Keywords
Wooden multistory construction; wood construction; sustainable development; construction; forestry; qualitative content analysis; theory of planned behavior

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Muita tietoja – Övriga uppgifter – Additional information

Preface – KäPy, Taste of Wooden Living

This research constitutes one sub-project nested under the Helsinki University research group KäPy–Taste of Wooden Living. KäPy is a three-year research project focused on investigating the relationship between consumer needs and wood based multistory housing. The aim of the group is to provide research that guides the wood-based building and construction sector, as well as its multiple stakeholders.

The KäPy group is funded through public and private partners. Public partnership funders include Business Finland (formally TEKES–the Finnish Agency for Innovation and the University of Helsinki). Private partnership funders include: Dasos Capital Oy, Lapwall Oy, Lämpöpuuyhdistys ry, Upwood Design Oy, Thermowood, Westas Group Oy, Upwood Design, HTJ Oy, and Puusta Innovations Oy.

The group also collaborates with several universities. These partnership universities include the University of Vaasa, the University of British Columbia, and Linköping University.

Acknowledgement

Like all good things in Finland, the idea for this master thesis was born in a sauna. There was a heated debate with an architect over how building material choices in Finland occur, and the discussion ended with my (admittedly unfairly and naively) accusing Finnish architects of simply, "not wanting to design in wood." From that moment on, I wanted nothing more than to understand *why*.

I could not have been luckier to learn about the KäPy group and their work on wooden living just a few weeks after my sauna debate. I was even more fortunate that the KäPy group offered me a rare opportunity: the chance to pursue my own research.

It has been a long journey from what now feels like a serendipitous inspiration in the sauna. My thanks and gratitude must first and foremost go to the very person that inspired this stubborn question. Reko Laurilehto—this thesis would not have happened without you. Thank you for continuously sharing your architect wisdom and experiences with me. I am (not so) sorry to say you might continue to have to do so for several more years.

I would also like to thank the KäPy group, not only for taking me on as a researcher, but for offering me so much guidance and refinement on my initial research idea. To Ritva Toivonen, a special thank you for listening to my proposal and accepting my idea. To the rest of the KäPy group I must thank you all profusely for your help on a topic I knew nothing about when I began. It is with much eagerness that I hope to keep learning from your wisdom and experiences! And some special extra thanks for all the reading everyone has endured because of this thesis (especially Anne Toppinen - an apology is in order along with promises to extend the same curtesy whenever you desire!!).

As a final word, I would like to mention that I wake up every day and think about the good fortunate I have had to end up in Finland. The system that allowed me to come study in Finland free of charge, regardless of not being from an EU state, puts on me some social burden that I cannot know I will ever be able to repay—but I will strive to do so. I plead to those who doubt or are against these systems: reconsider. There is a necessity to promote humanitarian acts which establish freedom of education and opportunity for individuals regardless of where that individual comes from. If I were Finnish, I would be proud to know that I have supported someone in coming closer to achieving their dreams. Because indeed, that is what Finland has done for me.

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1. Introduction

1.1. Motivation for study

Since the early 1990's the state administration of Finland has been supporting the entry of wooden multistory construction[1] (WMC) into the Finnish construction sector and residential housing market. The onset of WMC projects into the path-dependent and concrete material dominated regime of Finland has been paved by government regulations as opposed to end user market demands (Toppinen et al. 2017a). This is a distinction given that material innovation in the construction industry is traditionally connected to either a desired change in the product by the end user, or a desire to affect costs and availability by the builder (see: Bowley 1960).

A variety of reasons drive the state administration to support WMC. First, the practice satisfies aims to strengthen Finland's bioeconomy-viable forest sector by increasing demand for the value-added engineered wood products used in WMC frames (see: Bioeconomy 2014). Second, the use of wood acts as a substitute to other emissions-intensive materials (Sathre & González-García 2014), thereby satisfying the EU's Paris Climate Agreement collective target to reduce greenhouse gas emissions by 40% relative to level of 1990 by the year 2030 (see: EU 2015; UN 2015; EU 2016; TEM 2017).

Support for WMC in Finland culminated in a series of legislative changes allowing WMC to enter the housing market. Prior to 1994, national fire safety and building code regulations did not allow for the construction of WMC projects. In 1994, fire safety legislations were amended to allow residential WMC projects up to 4 floors in height. The legislations were amended yet again in 2011 to allow WMC projects up to 8 floors in height (Karjalainen 2018). As a result, 63 WMC buildings totaling 1,545 residential market dwellings have been finalized between 1994 and 2018 (PuuInfo 2018). A similar trend was seen in Sweden, as the enactment of government policies enabled the development of WMC under a path-dependent market regime (Mahapatra & Gustavsson

[1] Wooden multistory construction refers to buildings of 4 or more floors whose load-bearing frames primarily consist of wood materials. The focus of this thesis is especially on residential multistory construction.

2008). The distinction between the two countries is that Finland has yet to normalize WMC as a construction practice in the residential housing market.

With each building code amendment, an intense upsurge of WMC construction followed—Hurmekoski et al. (2015) refered to these upsurges as "waves". The first wave began in 1994 but ended when WMC failed to breach the housing market and projects came to a standstill in 2006 (Hurmekoski et al. 2015; PuuInfo 2018). It is too early to say what the fate of the current 2011 WMC wave will be, but there may be barriers to overcome prior to WMC becoming a normalized building practice.

A recent study by Gosselin et al. (2017) compiled a meta-analysis of 53 scientific articles that addressed challenges in using wood as a multistory building material in both residential and non-residential buildings across North America and Europe. They concluded that 7 major project barriers exist: building costs; lack of industry expertise; building code challenges; skepticism regarding material durability; physical technical challenges of wood; the culture of the construction industry; and the lack of material availability (i.e. engineered wood products). In Finland, barriers to WMC have been attributed to cost, the path-dependent nature of the concrete industry, and uncertainty toward the materials technical qualities compared to that of concrete (Riala & Ilola 2014).

Gosselin et al. (2017) also noted that most of the information regarding WMC in the literature was obtained via architects or structural engineers. They saw this as a bias because their study was concerned with establishing barriers throughout the whole wood construction industry chain, and thereby acknowledged a large perspective gap in their literature. But this gap is also an indication of the lack of stakeholder perspective on the topic of WMC in general, given that Gosselin et al.'s data consists of a synthesis of various present-day literature on WMC barriers and motivators.

From the Finnish standpoint, one of the major stakeholders in the planning and development of residential housing are Finnish municipalities. Civil servants—who are responsible with complying to national strategies while being tasked to satisfy the needs of Finnish citizens—are legally entrusted to oversee and approve the planning of all zoning maps. This authority extends to all construction projects across Finland and

includes the power to compel builders to comply with certain material preferences through zoning regulations (Act 132/1999). Yet the lack of WMC projects in Finland might be interpreted as a counterintuitive trend: If for two decades the state administration has been encouraging wood construction, then why is WMC not a normalized construction practice—at the very least among projects led by the municipal gatekeepers of construction?

Based on limited sources of current academic research (e.g. Hurmekoski et al. 2017; Toppinen et al. 2017a; Lähtinen et al. 2018), it is not possible to pinpoint the bottleneck factors preventing the intensification of wooden projects from the Finnish municipality point of view. This is by large the greatest motivation for this study. As such, there is a desire to set a current-day precedent of the perceptions civil servants hold regarding WMC. This work therefore endeavors to bridge the gap between institutional research and knowledge on the topic of WMC in Finland.

1.2. Research questions

The research questions addressed in this project focus on examining multiple facets of the city planning processes occurring within Finnish municipalities as they pertain to using wood as a material for residential multistory construction. This research attempts to identify key perceptions within Finnish municipalities regarding WMC, specifically those experienced by the civil servants working within the bureaucracy:

1. *What kind of attitudes do civil servants hold concerning wooden multistory construction?*

2. *What kind of perceptions do civil servants have on the attitudes of external actors regarding wooden multistory construction?*

The purpose of this study is to explore the beliefs and values that various civil servants throughout Finland hold about wood as a material for multistory construction. This means investigating civil servants' personal attitudes towards WMC, as well as the attitudes of the actors other than themselves. It is important to explore not only the perceptions that civil servants hold, but also how the individuals arrived at these perceptions.

2. Contextual Background –Wood construction in Finland

2.1. The role of the forest sector in Finland

The role of the forest sector in Finland has historically held great economic and social significance. While Finland was still a Grand Duchy of Sweden, Finland's forest management practices and forest legislations were often scrutinized by both Swedish and Finnish scholars (Brown 1883). Shortly after Finland's independence in 1917, Finland forfeited Karelia to Russia in 1940. During this time, the forest sector helped provide work to many of the 450,000 displaced Finnish refugees, and Finnish forest industries accounted for 95% of all Finnish national exports (de Gadolin 1952).

The Finnish forest sector of today employs fewer individuals than in the past, but still holds great social and economic value. In 2016, the forest sector employed 63,000 persons and grossed a production revenue of €19.8 billion EUR (LUKE 2017c). Currently, the forest sector accounts for approximately 4% of Finland's GDP (LUKE 2017b). But the sectors most unique social feature is its forest ownership trends. In a country where forests cover 75% of the landmass, approximately 60.9% of the total forest cover is owned by non-industrial private forest owners (NIPF)—the rest is owned by private companies (8.2%), the state (25.4%), or other entities (5.4%) (LUKE2017a). Forests in Finland are owned by the Finnish people.

The role of the NIPF is highly important given that they were estimated to dispense more than 80% of the commercial round wood purchased by the domestic forest industry yearly (METLA 2011). In 2016, NIPF's accounted for 85% of all round wood removals in Finland, and the primary revenue generated from felling and stumpage amassed by these citizens was €2.01 billion EUR (OSF 2017b). Forestry revenue continues to provide the average Finnish citizen with a relevant source of income, and in the same vein forest industries depend on Finnish citizens to supply their domestic round wood needs.

The provision of domestic round wood from NIPF's provides the fuel for forest industries to create value-added commodities for domestic and export consumption. In 2016, Finnish forest industries consumed 58.9 million m^3 of domestically produced round wood (OSF 2017a) and produced 11.4 million meters of sawn good and 1.1 million meters of plywood

(LUKE 2017d). Meanwhile, forest sector exports generated €11.7 billion EUR and by the end of 2016 totaled 22% of Finland's total value good exports (LUKE 2017a). Therefore, the value of Finland's forest industry is largely created from the domestic round wood produced by the average Finnish citizen, and overall the forest industry provides larger gross revenue to the country through the creation of value-added wood products than would citizens by just providing round wood for export.

Socioeconomics aside, what has until recently been left undiscussed is the forest sectors role in environmental practices. The 1987 Brundtland Report stated, "Humanity has the ability to make development sustainable to ensure that it meet the needs of the present without compromising the ability of future generations to meet their own." Thus, the importance of synchronizing socioeconomic growth with environmental limitations became a key argument in global discussions, and the Finnish forest sector was not exempt from this conversation.

That forestry practices directly impact the environment is not a new notion, but recently the Finnish forest sector has gone from being cited as a source of environmental catastrophe to being recognized as a potential environmental ally (Hansen 2016). The sector can provide a suite of solutions to environmental dilemmas (e.g. resource depletion, climate change), as strategic pathways and tools become available for the sector to fulfil these goals. One such strategic pathways has been shaped by the bioeconomy agenda.

The original concept of the bioeconomy was shaped by Enriquez-Cabot's (1998) impressions on genomics creating a new global stage for bio-based industries applying biologically-based technologies to their products. 20 years later the concept of a "biobased economy" has been reshaped through various discourses (Roos & Stendahl 2015) and refers to an economy that goes from relying on fossil fuel to relaying on bio-based renewables. This definition is adapted into EU and Finnish political discourses regarding the bioeconomy (EU 2012; Bioeconomy 2014).

The EU's Bioeconomy Action Plan (BAP) seeks to address concerns with finite natural resource exploitation under growing global demand, as well as impacts of environmental degradation, mitigating climate change, and reducing dependency of fossil fuels while

maintaining job, investment, and research growth (EU 2012). Finland's Bioeconomy Strategy Plan (BSP) aims to enable low-carbon pathways, reduce consumption of fossil fuels, increase the use of renewable resource, and prevent biodiversity loss while still generate economic growth and jobs (Bioeconomy 2014).

The role of the forest sector is therefore paramount to the bioeconomy agenda, as forests provide a renewable raw material for creating new and reliable products (Metla 2011). While the EU's BAP was scrutinized for foregoing mentions of the forest sectors role (Ollikainen 2014), Finland's BSP promotes forest and forest-based products as central components to achieving economic development goals while enabling a technology and research industry with the capacity to address environmental challenges (Bioeconomy 2014). Furthermore, Finland's BSP agenda synergizes with policy-making decisions, like the Ministry of Agriculture and Forestry's recent suggestion that Finland increase forest consumption by 10-15 million m^3 a year to meet BSP demands (mmm 2017).

Support for a Finnish bioeconomy agenda has also provided Finnish forest industries with an opportunity to effectively enable win-win conditions for innovation. Several authors have detailed the prospects, business model advantages, and innovative capacities which forest industries are poised to grasp sooner than other industries. This is merely due to the sectors's capacity to harmonize with bioeconomy aims (see: Maunula 2014; Roos & Stendahl 2015; Hansen 2016). In Finland, this opportunity is strengthened by the strong socioeconomic relevance of the sector. One future study report concluded that by 2030 pulp and paper industries could realize as much as 40% of revenue from the creation of new products not currently existing in the market, but only if industries adapt their current business logic strategies to reap these positive profits (Toppinen et al. 2017b).

That the Finnish forest sector could rise to meet the bioeconomy agenda is necessary, not just for the implied shareholder value in industry stock, or for the derived benefit to the country's GDP, but because wood is a renewable resource that answers challenges related to large social problems. It is for these reasons that the sector must explore potential frontiers for innovation as there are many opportunities for engagement.

2.2. Wooden multistory construction: Room for innovation?

In 1994 Gann (1994) encouraged research on construction innovation. He acknowledged that the construction industry was painted as "backwards" for failing to realize technological maturity or hasten industrialization processes at a rate equal to other industries of the time. Since then, a variety of methods for enabling construction innovation have been suggested in the literature (e.g. Akintoye et al. 2012; Orstavik et al. 2015), but the sector is still seen as slow to change.

Construction innovation has also unfolded as a multi-faceted discourse in Finland. One such discourse examines how the construction material sector has gone largely dismissed from construction industry innovation conversations, despite the sector's fundamental role as an intermediary in the construction industry value chain (Koukkari & Orstavik 2015). Economically speaking, the manufacturing of construction products within the European Union accounted for an estimated €360 billion turnover in 2009 (Ecorys 2011). Construction product manufacturing, when integrated with the broader construction sector, accounts for 66% of Finland's national economy investments (RT 2013).

One potential avenue for construction innovation exists between the Finnish forestry wood value chain and the construction sector given that construction grade timber and engineered wood products are high-value products made from trees (Ramage et al. 2017). Many Finnish stakeholders acknowledge the cooperative potential between the two sectors. For example, Finland's state administration acknowledges both sectors together could help provide sustainable development solutions (Bioeconomy 2014). NIPF's also perceive a socioeconomic benefit to both sectors cooperating (Häyrinen et al. 2017). The Ministry of Economic Affairs and Employment also believes timber construction could lead to new value chains that benefit Finland (TEM 2017).

Public opinion holds that the use of wood as a building material offers a conduit for amalgamating various agenda issues between the public and private sectors. Nonetheless, construction material trends show the opposite of this occurring, and the industries are not cooperating closely enough. Culturally speaking, using wood as a building material in Finland is not uncommon as 80% of sawn timber consumed domestically in Finland is

used for construction purposes (TEM 2017). Wood has primarily been used for the construction of frames in single-detached homes since the post-war reconstruction era of the 1950's (Davey & Nikula 2011). On the other hand, concrete frames are primarily used for multistory construction projects (e.g. residential apartment blocks, office buildings).

This concrete material trend developed due to the emergence of new construction technologies in the 1960's (Koukkari & Orstavik 2015) which enabled the mainstreaming of prefabricated concrete buildings. Quick and cheap, concrete prefabrication became a solution to satisfying the countries large housing demands stemming from increased urbanization. Migration from the countryside to urban areas has increased population densities in several regions throughout Finland (Oinonen et al. 2013), resulting in changes to the land-use patterns of residential building types across the country. These land-use trends parallel the increased use of concrete materials in residential buildings construction.

Between 1995 and 2016, 78% of all residential buildings were built in an urban setting. By 2016, 46% of all residential dwellings in Finland were in apartment blocks (OSF 2017d). The increase in the number of apartment block dwellings signals an increase in apartment block construction. Since the 1960's the total stock of concrete residential buildings increased from 3.5% to 13.1% while wooden residential building stock decreased from 96.5% to 84.4% (OSF 2017c). With 65% of the 30,300 dwellings constructed in Finland in 2016 being apartment blocks (OSF 2017d), it comes as no surprise that the total stock of residential buildings made from concrete has continued to increase while the total stock of wood residential buildings has seen a downturn.

Despite the availability of construction grade timber and engineered wood products, wood has not expanded to building practices outside single detached homes in Finland. WMC has only recently started to gain ground in the residential housing market. Finland's first WMC project was completed in Ylöjärvi for the 1996 National Housing Exhibition. It consisted of three buildings, three floors each, totaling 19 dwellings (Vepsäläinen 1996). By the end of 2011, only an additional 30 WMC buildings had been completed (PuuInfo 2018). The implementation of WMC was slow since its inception and for 15 years represented a housing market share of less than 1% (Hurmekoski et al. 2015; Hurmekoski

et al. 2017). Between 2011 and 2017 the number of WMC residential dwellings doubled, increasing from 649 to 1,437 (PuuInfo 2018).

Yearly residential market share estimates for WMC fluctuate considerably and building finalization is somewhat patchy. For example, early 2014 estimates assumed that WMC residential dwellings would account for 10% of the 2015 residential market share given that 1,500 apartment dwellings would be completed by 2015 (Hurmekoski et al. 2015; TEM 2015). These projections did not successfully develop. Only 8 WMC buildings went online in 2015, totaling 368 apartment dwellings, (PuuInfo 2018) and therefore accounting for a 2% market share. More recently, Hurmekoski et al. (2017) estimates that 3,000 WMC apartment dwellings will be in the market by 2018, and thereby account for 7% of the total market share (see: Figure 1).

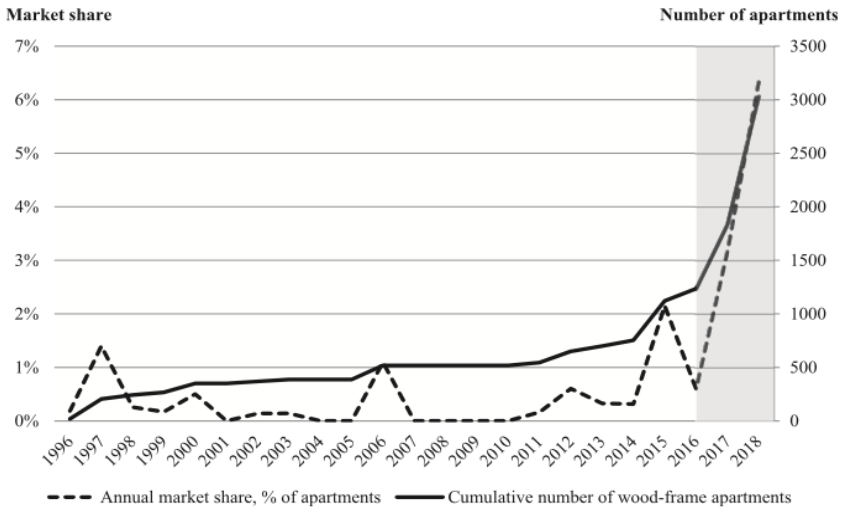

Fig. 1. Market share development of wood-frame multi-story construction in Finland (Tolppanen, 2016; Statistics Finland, 2017). Data for 2017–2018 are based on planned construction project completions.

Figure 1- Historical market share of WMC, and projections for 2017-2018. WMC has shown a 2.5% market share increase since the first project in 1997. Projections for 2018 estimate a 6% market (Image from: Hurmekoski et al. 2017)

The milestone figure of a 10% residential housing market share is not arbitrary—it is a figure which the state administration of Finland was seeking to fulfil between 2011 and 2015. However, state administrative support dates back much further than this aim. State interest spawned the TEKES 1995-1998 Wood in Construction Technology Programme [*Puurakentaminen 1995-1998*] which sought to implement building systems and processes to enable wood construction, and wood product development (TEKES 2000). The program was ambitious—given that there was no "wood construction sector" at the time—and succeeded at laying the foundation for a wood construction sector by creating

both awareness and a positive image for wood construction technologies. This program also coincided with the 1997 fire regulation building code amendment that allowed building facades to use exposed wood materials, and the construction of load-bearing wooden frame buildings up to 4 floors (Karjalainen 2016). This regulation also permitted the several WMC pilot projects of the early 90's (TEKES 2000; Puuinfo 2018). Still, WMC failed to achieve a market breakthrough.

More recently, a second wave of WMC projects was spurred by an additional amendment to Finland's fire safety building code. In April 2011, fire regulations were changed to allow for the construction of wooden frames buildings up to 8 stories, given that unique sprinkler systems were installed in the buildings to mitigate fire risk (PuuInfo 2018). At the same time, the Programme of Prime Minister Jyrki Katainen created the Forestry Strategic Program 2011-2015 [*Metsäalan strateginen ohjelma 2011–2015*] with the first objective being to increase wood construction (TEM 2012). This same plan set the milestone to increase WMC to a 10% market share of residential housing (see: Table 1).

Table 1 – Translated table of development objectives from TEM 2012. Original table, titled "Metsäalan strateginen ohjelma 2011–2015: Väliraportti ja toimenpideohjelma", can be found on page 13 of the report.

The overall development objectives of the forest sector set in the MSO

The main objectives	Development Objective	2010	2015
Wood Construction	1. Market share of WMC	1 %	10 %
Wood Products	2. Value of timber product exports	.5 mill €	1 mill. €
Basic Forestry	3. Value of forest industry products	11 mill. €	13 mill. €
New innovations and new products	4. The value of the new business in the forest sector	0	+250 mill. €
Use and purchase of wood (round wood)	5. Domestic wood use	52 mill. m^3	65-70 mill. m^3
Use and purchase of wood (energy)	6. Use of forest chips	6.9 mill. m^3	12 mill m^3

In 2015, WMC aims became nested under the "bioeconomy and clean solutions" strategic plan following new administrative directive. WMC is discussed as a key product in the project "Wood on the move and new products from forests" which highlights several objectives including that the "red tape on construction that prevents the use of wood will be cut" (Prime Minister's … 2015). While there are no current market share targets for WMC, there does concurrently exist support for WMC in the National Forestry Strategy 2025 [*Kansallinen metsästrategia 2025*] (2015) and the earlier mentioned BSP

(Bioeconomy 2014). Ultimately, the interest of Finnish government in supporting WMC has largely been a result of the administrations quest for sustainability (Koukkari & Orstavik 2015). But whether WMC will culminate in the innovation between two prominent industry sectors, or even achieve a position as a normal construction practice remains to be seen. Precedent exists, but challenges remain.

2.3. Finnish Municipalities: Gatekeepers of Construction Projects

In this paper, Finnish municipalities are referred to as the "gatekeepers" of construction because they are the authorities that control all decisions related to land-use and zoning. This authority is legitimized legally by the Ministry of Environment's Land Use and Building Act (Act 132/1999). Three legal zoning powers exist in the Land Use Act: the regional plan, the master plan and the detailed plan.

The regional plan provides a general framework focused on broad national objectives that help steer master planning and detailed planning (Section 28, Act 132/1999). Only a few points exist within the regional plan. The focus is to ensure cohesion between municipalities whose jurisdictions are joint by settling questions or conflicts of a larger scale, like natural landscapes maintenance or large infrastructure project development (Ympäristöministeriö 2005). Regional plans are created and approved by regional councils made up of representatives from local municipalities but are confirmed by the Ministry of the Environment. Municipalities still thereby hold key influence over the zoning and planning decisions in these large-scale projects.

Unlike the regional land use plan, the detailed plan and master plan are not subject to confirmation by the Ministry of Environment and are instead prepared and approved by each local municipality jurisdiction in question. Both plans enable municipality administrations to individually dictate how to develop their land so long as they follow national guidelines.

The primary purpose of the local master plan is to give guiding principles to all projects planned within that zone. Section 39 (Act 132/1999) outlines 9 core objectives which must be met along with any objectives stated in the regional plan. Objectives are broad but ensure citizens are provided with all the effects necessary to inhabit a functional and

developing area. Figure 6 (Appendix D) provides an example of a 2016-2050 master plan for the city of Helsinki.

The detailed plan aims to dictate granular elements of individual construction projects which would be found within a master plan. 5 strict requirements must be addressed in the plan to ensure the minute details of a plan are satisfied. These includes specifying map boundaries, detailing the use of public and private areas, outlining all building volumes, and stating the principles which govern a buildings location or its construction type (Act 132/1999). Figure 7 (Appendix D) provides an example of a local detail plan for the Honkasuo neighborhood in Helsinki.

Within the zoning plan, municipalities may also issue regulations to maintain special guidelines for land use and buildings or to preserve protect landscapes and environments (see: Section 41; Section 5 in Act 132/1999). An example of regulations can be seen on the Honkasuo detailed plan alongside the legend. They include details pertaining to the nature of the built form of the area (e.g. uniformity, orientation, and material use), the nature of public spaces, the function of buildings to be erected, and other topics.

It is relevant to note that no section of The Land Use and Building Act has a provision explicitly discussing in detail how specific the zoning details or regulations draw into plans should be. The spirit of the land use codes is general, presumably because this enables municipalities to draft flexible plans to suit individual municipality needs. Even so, a municipality may choose to include highly specific details in a plan, like frame material, façade materials, or even if all homes in an area should have a fireplace or not. For example, the Honkasuo plan requires all homes to have fireplaces and that all buildings be made of wood (Helsingin Kaupunki…2008).

The Honkasuo plan was heavily debated at town councils because it included regulations that force builders to comply with the use of wooden frames and wooden facades during construction (Helsingin Kaupunki…2008). Since material selection is not specified explicitly as a provisional regulatory power that may be applied to detailed plans, builders argued municipalities should not have the authority to force material compliance, and that material decision should be left to builders. This debate culminated with grievances being

taken to the Supreme Administrative Court of Helsinki.

After a series of appeals, the Supreme Court ruled in favor of the City of Helsinki stating they indeed have authority to make such demands in their local detailed plans (KHO 2015; Päätokset 2017). This cemented the validity of the municipalities as the ultimate authority of construction projects. Municipalities not only approve zoning plans permitting construction, but also have the authority to force a building to be constructed according to their expectations.

While the Supreme Court's decision set a precedent for municipalities to create detailed plans that enforce material selection, zoning for wood material compliance rarely happens in Finland. This can be discerned by the limited number of projects that have been constructed over the years (Puuinfo 2018). Understanding what drives municipalities to approve or deny projects WMC is critical for the future diffusion of WMC. And if it is the task of the policy maker is to identify and formulate a societal problem (Lindblom 1968), then Finland's state administration has already declared their expectations from municipality to promote wood construction (TEM 2012).

3. Theoretical Framework

3.1. Conceptual Design - Theory of planned behavior

An investigation into why Finnish municipalities proceed or abstain from implementing WMC projects requires systematic research that peels back and reveals perceptions held by civil servants. Ajzen's (1985) theory of planned behavior (TPB) was chosen as the theoretical framework upon which to build a conceptual model for exploring the various. By simplest definition, TPB is concerned with how the intent to perform a behavior (e.g. the decision to engage in WMC projects) is influenced by three subjective motivations:

1) The subject's personal attitudes regarding the behavior;
2) The subject's perception of social norms surrounding the behavior; and
3) The subject's perceived personal control over implementing the behavior
(Ajzen 1985; Ajzen & Madden 1986; Ajzen 1991).

The TPB framework model therefore provides a simplified foundational avenue for dissecting behaviors based on three overarching categories: *attitudes*, *norms*, and *perceived behavioral control* (see: Figure 2).

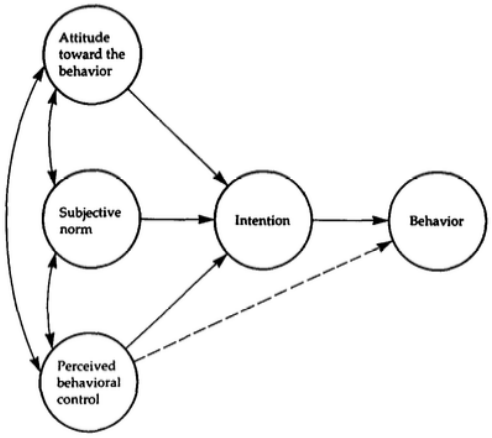

FIG. 1. Theory of planned behavior.

Figure 2 –from Ajzen (1991). The intention to perform a behavior are guided by 3 principals. This figure is a simplified design of how the intention to perform a behavior are formed, and ultimately lead to a behavior.

TPB gained its popularity as a tool for predicting behavior after Ajzen (1985) expanded on previous attitude-behavior research related to the "theory of reasoned action" (Fishbein & Ajzen 1975; Ajzen & Fishbein 1980). The theory of reasoned action was originally concerned with the motivations driving a subject towards the intention to perform a given

behavior. Specifically, motivation being guided by a subject's *attitudes towards the behavior* and their *subjective norm* (Ajzen & Fishbein 1980; Ajzen & Madden 1986).

TPB highlights motivation as the primary precursor to executing a behavior but concludes that an individual's intentions (i.e. attitudes and beliefs) alone do not account for the success of a behavior coming to fruition. TPB also incorporates perceived non-motivational factors as an antecedent to behavioral actions (Ajzen 1985). While a non-motivational factor (e.g. money, time) can prevent a behavior from being executed because of its lack of actual existence in a subject's environment, an individual's perception of whether said non-motivational factor is lacking is subjective. That subjective motivation impacts whether an individual will attempt a behavior.

For example, if a person perceives that they have no time to complete a task—regardless of whether this is the reality of the situation or not—then the individual will assess the difficulty of executing the behavior to be high, thus diminishing their intent to perform the behavior. Ajzen (1985) coined this additional intrapersonal perception as *perceived behavioral control*, with the concept being defined specifically as "the subjects assumed difficulty to engage in a behavior".

At its inception TPB was interested in the predictive validity behind a subject's intention. Research focused on behavioral differences in social conducts ranging from medical behaviors like problem drinking, to political behaviors like voter turnout (Ajzen 1991). With research supporting the validity of TPB as a predictive model, TPB has shifted in use from being just a predictive behavioral tool to also being implemented as a determinant of the intents behind a behavior (Ajzen 2011).

Recently, TPB has been used by researchers to investigate the perceptions of various stakeholder groups regarding the use of wood as a frame material for multistory construction. TPB was usually used to explore underlying attitudes (see: Roos et al. 2010; Hemström et al. 2011; Viļuma & Bratuškins 2017) and in one case used as a predictive model to test a hypothesis (Bysheim & Nyrud 2009).

3.2. Framework application and interview guide development

While the original purpose of TPB was to predict behavior, in this thesis TPB is used to explore the antecedent leading to behaviors. At this stage, the concern is not predicting if the civil servants are interested in implementing WMC projects, but rather to explore the formation of the intention, regardless of execution or interest. An interview questionnaire was developed by the author with guidance from KäPy members. Questions follow the three antecedents of TPB and were justified by the previous literature.

In TPB, *attitudes* are defined as, "the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question" (Ajzen 1991), or "the individuals positive or negative evaluation of performing the behavior" (Ajzen 1985). The *behavior* in question here is engaging in WMC projects. Frame 1 translated to:

1. *Municipal level attitudes towards urban residential WMC* projects*

The sub-questions under this guiding theme were chosen based on previous WMC attitude research, and the premise that the civil servants are approaching matters related to city planning based on the best interest of the resident. The sub-questions for Theme 1 were:

1.1. What is the vision and strategy of the city in terms of development and housing? Is there a formal strategy? What is the role of urban residential WMC in this vision?

1.2. What do you as an individual see as the advantages and disadvantage of using wood materials in WMC? Have you ever worked with a WMC project, and if so how?

1.3. Does the municipality have formal criteria related to the living environments in homes? If so, do they assess the homes criteria post-construction?

Sub-questions 1.1 was used both as an ice-breaking interview question and to see where current trends for WMC stand in the municipality. Sub-questions 1.2 addresses the question of attitudes regarding WMC. We wanted to know what the participant found favorable and unfavorable about WMC. We asked if the subject had any previous work with WMC to investigate if experience shaped attitudes. Sub-questions 1.3 was chosen because it relates to the question of regulatory barriers which often comes up in WMC

research. As Bysheim & Nyrud (2009) pointed out with their TPB study, height restriction on WMC was a most cited reason limiting architects from using wood. This question attempts to explore the municipality take on regulations or criteria that may be hindering WMC.

Subjective norms are defined as "the perceived social pressure to perform or not perform the behavior" (Ajzen 1991), or "the person's perception of the social pressures put on him to perform or not perform the behavior in question" (Ajzen 1985). It is important to understand who civil servants considers to be relevant stakeholder, and what civil servants consider the opinions of those stakeholders to be. Frame 2 was set as:

2. *Actors involved in urban residential WMC*

The sub-questions in this frame attempt to establish which stakeholder civil servants believe influences the municipalities' choice to engage in WMC projects, what the civil servant believe those stakeholders think about WMC, and how the civil servant arrived at those perceptions. The sub-questions for Theme 2 were as follow:

2.1. What actors weigh in on the decisions for or against using wood as a material in urban residential WMC? What channels of communication exist between the municipalities and these actors?

2.2. How do end user wants and needs affect urban residential WMC in the city? How does the city communicate with the end users about their wants and needs?

2.3. How does communication takes place between the municipality and builders throughout the WMC project and after the WMC project is completed?

Sub-question 2.1 generally addresses the questions of who the actors are, what they think of WMC, and how the civil servant reached this conclusion. Sub-question 2.2 was specifically directed at the end users because we assumed that as a municipalities' role is to act in the interest of the citizens they serve (e.g. end users) and therefore the perceptions the civil servant holds regarding this cohort is highly paramount. Sub-question 2.3 was chosen under similar grounds as Sub-question 2.2. The builders are responsible for

carrying out a project which the municipality approves, therefore it is assumed that the perception of the builder is highly considered by the municipality.

Perceived behavioral control is defined as "the subjects assumed difficulty to engage in in behavior" (Ajzen 1991) and is a product of interpersonal perceptions regarding the necessary resource needed to perform a behavior. Frame 3 was therefore:

3. *Contextual influences that cities believe impact urban residential WMC adoption decisions.*

As municipalities have the legal authority to apply regulations which force construction of buildings with wood frames, it is assumed that the contextual influence of implementing WMC projects is hindered by a greater contextual influence than authority.

3.1. *What processes exist for gathering new information on design and building technology about WMC? How is this information communicated throughout the municipality?*

3.2. *Are there any other issues which you find to be important that have not been discussed?*

Sub-question 3.1 addresses a broader contextual question that directly relates to the practice of WMC. Communication, access to information, and knowledge (or lack thereof) about the subject could all create potential obstacles, therefore it is important to assess their status in the eyes of the civil servants. Roos et al. (2010) highlighted wood construction related knowledge and access to information as potential issues that enable or limit WMC construction. Their research nested these as *perceived behavioral control* factors, and this study follows suite.

Sub-question 3.2 addresses subjects of perceived behavioral control by directly asking the participant their thoughts on relevant issues which may not have been discussed. It was assumed that the participant would discuss retroactively some facet which had gone previously unmentioned. In retrospect, having left this question last may be a limitation as the question could be interpreted as a closing statement to the interview rather than a continuation to share insights.

4. Data and methodology

The object of study in this research is the perceptions of civil servants working in Finland. Outlined below are the justifications for undertaking a qualitative research approach, conducting semi-structured interviews to gather data, and using qualitative content analysis (QCA) to study the data.

A qualitative design process was chosen to tease out perceptions regarding WMC among civil servants working in various Finnish municipalities. The definition of qualitative research is divergent given both the large range of methodological approaches and the vast number of disciplines implementing the approach (Snape & Spencer 2003). But generally, the underlying principle behind qualitative research is the study and interpretation of society and its singularities (Bryman 1988; Denzin & Lincoln 2000; Snape & Spencer 2003), thus the aim is not to test for a hypothesis but rather to interpret a phenomenon.

Semi-structured interviews were considered the best approach to collect the data for this study. Structured interviews would have been too rigid to use as a thematic exploratory tool given their nature to produce sterile and limited responses (see: Fontana & Frey 2000; Edwards & Holland 2013). Unstructured interviews would have lacked acknowledgement of the *a priori* research used to design the interview questionnaire, as unstructured interviews are open-ended, and without predefined questions or topics (Klene et al. 2013).

Semi-structured interviews provide an overlapping data collection method between structured and un-structured interviews by soliciting both close-ended and open-ended responses from participants (Klenke et al. 2013). The semi-structured interview process allows for interpersonal perspectives to shape the interactions of both the interviewer and the participant, thereby fostering the development of new themes apart from those originally being explored by the interviewer (Edwards & Holland 2013).

In the case of this research topic, some previous WMC perceptions and attitudes literature exists, but few studies include the attitudes of civil servants (see: Roos et al. 2010; Viļuma and Bratuškins 2017). It was therefore anticipated that new themes would arise. Notwithstanding, Viļuma and Bratuškins' (2017) article was published in December 2017, after all but one of the civil servants had been interviewed. Likewise, Lähtinen et al.'s

(2018) study on Finnish city planners is currently a manuscript that mainly focuses on lobbying and sustainability perceptions. At the time of this researches inception, no Finnish civil servant opinions on WMC were specifically acknowledged in the literature.

Interview participants were chosen based on convenience sampling, so results from this study lack generalizability (Bornstein et al. 2013). The main condition for participation was that the role of the candidate be directly related to city planning and strategic development, preferably in a high-level or management position. Candidates that were unable to attend were occasionally asked to pass their invite to a colleague they believed would be a suitable candidate for the research. Interviewees were also asked for participant recommendations post-interview (see: snowball sampling, Goodman 1961).

11 in-person interviews were conducted between May 2017 and January 2018. These 11 participants consisted of representatives from the municipalities of Espoo, Helsinki, Rauma, Seinäjöki, Turku and Uusikaupunki. The roles of these civil servants involved high-level strategic planning and development or project management positions. For the sake of anonymity, participant's exact titles in the administration are not used. All interviews were held in English at the office of the interview participant. The average length of the interviews was 60 minutes. All interviews were audio-recorded then transcribed by an external company.

One interview suffered damage upon recording and had to be re-recorded, but the results were still included in the study as they did not decrease the value of the information. Participants were asked questions according to the semi-structured questionnaire (see: Appendix A). Once interviews began to reach a point of saturation where relatively little new information was presented they were discontinued. Transcripts were uploaded to the *Atlas.ti* software and analyzed by means of qualitative content analysis.

QCA is a method used to analyze qualitative data. QCA provides a systematic, reductive and comparative method for identifying themes within data, while simultaneously accounting for the frequencies with which said themes presents itself across the data (Spencer et al. 2003; Schrier 2012). In this research, Schrier's (2012) method of QCA is

used. Presented below is Schrier's outline for carrying out a QCA analysis, followed by a description of the method. The steps are as follows:

1. *Deciding on your research question*
2. *Selecting your material*
3. *Building a coding frame*
4. *Dividing your material into units of coding*
5. *Trying out your coding frame*
6. *Main analysis*
7. *Interpreting and presenting your findings*

The QCA process is relatively straight forward: by using inductive or deductive knowledge, the data being analyzed is reduced and fit into main categories and their subcategories. These categories and subcategories together create the coding framework. The coding framework is then used systematically across all data to divide the data into relevant units of coding, thereby reducing the amount of data being analyzed. Each unit of coding that is regarded relevant is then placed under a maximum of one sub-category from each of the main categories in the coding framework. This both quantifies how often a subcategory appears in the data, and allows for comparison of data. The QCA method ultimately provides two major results: the explorative, thematic interpretation of the data which occurs while constructing the coding framework categories, and the quantitative analysis of occurrence between categories across all the data. (Schrier 2012)

QCA was chosen as the method for analyzing the data in this research project for various reasons. First, QCA allows data to be reduced, which in the case of interviews is highly useful to interpret and manage data. Second, the creation of the coding framework based on inductive and deductive knowledge allowed previous attitude research on WMC to be considered in the analysis of the data.

Subcategories were created both inductively and deductively. Some groups were created by analyzing the data line by line, and progressively summarizing the results until categories could be discerned. Other groups deductively followed the results of previous literature (Bysheim & Nyrud 2009; Roos et al. 2010; Hemström et al. 2011). This strengthened the research because attention could be paid equally to new and old attitudes of WMC. Ultimately, QCA allowed for the observation of new topics that had previously not been brought up, while expanding and incorporating the views of previous research.

Another principal reason for using the QCA method was that it allows for comparison across the data. Frequencies of categories can be compared against different interviews, or even amidst the same case. Categories can also be cross-referenced to one another statistically or in group comparisons. This was deemed an asset which might help to offer deeper insight and understanding to why perceptions and attitudes are variable among civil servants, or what might be influencing these perceptions. Lastly, the QCA method was chosen because it is a reliable and a valid scientific tool for analyzing data.

Several potential limitations must be considered in this research. First, interviews were held in English, a non-official language of Finland. This limited the number of participants who could engage in the interview process. While no candidates rejected participating in the research due to a language restriction, there were two cases where other civil servants admitted that the language barrier was the culprit of non-response by some candidates. Asides from limiting the number of participants, it should be noted that the purpose of this research is exploration of perceptions through dialogue, and the exploration is severely limited by a diminished capacity to engage in dialogue to the fullest extent possible (as may occur with non-native language communication).

The second limitation in this research can be attributed to social desirability bias. All interviewee candidates expressed their support for WMC, and expressed that they themselves are at least interested in the topic. None of the participants discussed strong disregard for the material, or even the idea that it should not be used. Only 2 participants believed that materials choice should be left up to builder to decide (thereby limiting admission of their support). This bias could have narrowed the window of responses regarding personal attitudes towards wood as a construction material.

Participants were often shy about directly answering who they believed the actors that influenced WMC practices to be, and rarely discussed WMC opponents when asked directly. This was interesting because throughout the interview, the interviewee would discuss different actor groups quite casually. It could be there is a social taboo of discussing and naming parties directly in an attempt to not “throw anyone under the bus”.

Schrier (pg. 167, 2012) approaches reliability in qualitative research as a criterion that measures whether an instrument is free of error. She proposes that the instrument (i.e. QCA framework) can thereby be tested for errors through means that assess the frameworks consistency. As such, Schrier proposes two methods for testing consistency: 1) across person; or 2) across time. The framework is consistent if in either of these cases it produces the same results with the same data. Then it is reliable. As an aside, reliability does not presuppose a binary scale—as some instruments can be more, or less, reliable than others. Reliability can be interpreted as a "coefficient of agreement", when the number of agreed codes between the data is divided by the total number of unit codes in the data. When multiplied by 100, this produces a percentage of agreement.

Because only one researcher was coding the data from this study, it was only possible to measure reliability through stability across different points in time (Schreier, 2012, p. 167). A random 10% sample of the coded data was re-coding 4 months after being originally coded. The codes were then compared between the original sessions and the re-coded session. The reliability check showed an 86% agreeance.

Schreier (2012, p. 175) defines validity of the QCA method as the accuracy with which the framework captures and represented the information it was initially tasked with analyzing. In qualitative science, the assessment of validity is surround by philosophical debates on best methods, and the ability to even measure validity (see: Merrick 1999). Schrier (2012) argues QCA is a valid method of analyzing material regardless of the latent meaning of content being analyzed, so long as the necessary steps are taken to increase validity. She warns that making inferences beyond the scope of the data presented could result in a loss of validity if the claims lack corroborating research. If the QCA framework makes several inferences, then assessing validity requires a more complex method of analysis. In this research, no complex inferences about the data were made while creating the coding framework. All subcategories were created by direct interpretations of the data.

5. Data Analysis and Results

5.1. Civil servant attitudes concerning wooden multistory construction

The first research question that this study aimed to answer was the current day attitudes that civil servants hold regarding WMC. By using QCA to analyze the data, a combination of qualitative and quantitative results emerged. These results help illustrate the multiple lenses through which the interviewees perceive WMC. Presented below is a general overview of the QCA coding framework development, a quantitative analysis examining frequency of occurrences for each coding framework category, and an in-depth exploration of the qualitative themes that emerged from the coding framework.

5.1.1. The attitude coding framework

The subcategories nested under the coding frameworks major category **1.0 WMC Attitudes** were derived from both data-driven and theory-driven analysis. Aspects from previous studies on attitudes towards WMC (see: Bysheim & Nyrud 2009; Hemström et al. 2011) shaped the of the subcategories by focusing the analysis on overarching concepts related to sustainability, project construction, project design, materials engineering, safety, and access to information.

Attitudes were then placed under one of the main categories: **1.1 Contributes to WMC Projects, 1.2. Hinders WMC Projects,** or **1.3 Neutral**. This was determined by the statements made by the civil servant. In the case where an attitude towards WMC was shared without an opinion regarding whether this topic contributes or hinders WMC project implementation, previous research on WMC was used to guide the decision to nest the attitude under a main category. A total of 36 subcategories were created to satisfy the inclusion of all the interviewees' attitudes towards WMC (see: Appendix B).

Subcategories nested under **1.1 Contributes to WMC Projects** were topics that make the erection of WMC projects more favorable due to a beneficial or advantageous quality of WMC. The exception being **1.1.16 Interested in WMC** which catalogues phenomena where the civil servant mentions their general interest in WMC, but not precisely why. Subcategories nested under **1.2. Hinders WMC Projects** were topics that in some way would make the implementation of WMC more difficult by creating barriers.

Table 2 – Coding framework making up the major category 1.0 WMC Attitudes

1.1 CONTRIBUTES TO WMC PROJECTS (benefits)	
1.1.1 Supports Sustainable Development	1.1.10 Built Environment
1.1.2 Climate and Environment	1.1.11 Living Environment
1.1.3 Promotes New Business Opportunities	1.1.12 Construction/Renovation Ease
1.1.4 Supports Local Industries	1.1.13 Novel and Flexible Designs
1.1.5 Branding and Marketing Opportunity	1.1.14 Quality Standards
1.1.6 New Construction Opportunities	1.1.15 Encourages National Forest Sector
1.1.7 Price Competitive Aspects	1.1.16 Interested in WMC (General Support)
1.1.8 Safety (General)	1.1.17 Other
1.1.9 Increased Building Lifecycle	
1.2 HINDERS WMC PROJECTS (hindrances)	
1.2.1 Financial uncertainty	1.2.11 Building Lifecycle Uncertainties
1.2.2 Lack of experienced designers/planners	1.2.12 Safety Concerns
1.2.3 Lack of experienced builders	1.2.13 Project-Builder Communication
1.2.4 Slow Industry Development	1.2.14 End user Expectations Limited
1.2.5 Formal Regulations Lacking/Extreme	1.2.15 End user Apathy
1.2.6 Accessing WMC Info is Difficult	1.2.16 Limited City Support
1.2.7 No Branding/Marketing Opportunities	1.2.17 Design/Planning Limitations
1.2.8 Lack of WMC Knowledge (General)	1.2.18 Limited WMC Interest (General Opposition)
1.2.9 Cost	1.2.19 Other
1.2.10 Materials Technical Limitations	
1.3 NEUTRAL WMC OPINIONS	

Following the QCA method, the coding framework was created by segmenting three interviews into quotes; placing the segments into one of the three main categories; grouping the segments describing similar phenomena together; and creating subcategory names for all grouped phenomena (using previous research aspects as a guide). After producing the coding framework, the remaining seven interviews were segmented and coded according to the coding framework.

5.1.2. Frequencies of occurrence of personal cited attitude phenomena

The 11 interviewed civil servants held a variety of views and opinions towards WMC. In total, 277 quotes segmented among the interviews were cross-referenced as attitudes that the participants personally held towards WMC. Attitudes which were cross-referenced as beliefs held by other actors are not included in this section (see: Section 5.2). 89 of the 277 segments fit under **1.1. Contributes to WMC Projects**, 176 segments fit under **1.2. Hinders WMC Projects** category, and 12 segments fit under the **1.3 Neutral** (see: Appendix C, Table 10; Table 11).

There are twice as many examples of phenomena that hinder WMC implementation as opposed to phenomena that contribute to WMC implementation. This may be a reasonable

outcome given that WMC's position in the Finnish housing market is still considered a niche and has been growing at a slow place. It does not seem far-fetched that general discussion about a long-standing but non-normalized practice would revolve around the difficulties associated with the practice rather than the contributing aspects.

On an interview-by-interview comparative basis, participants on average each mentioned 8 phenomena that would be classified as contributing to WMC, and 16 phenomena that would be classified as a hindrance to WMC (see: Appendix C, Table 9Table 9). Only 1 civil servant mentioned more contributing phenomena than hindering phenomena.

In the **1.1. Contributes to WMC Projects** main category, interviewees most frequently mentioned: the importance of WMC for supporting climate friendly building practices (1.1.2); the heightened safety associated with WMC buildings (1.1.8); and how WMC could allow for the creation of novel and flexible building designs which other materials cannot achieve (1.1.13). The least mentioned topic included WMC's positive impacts on the feeling of the living environment (1.1.11).

In the **1.2 Hinders WMC Project** main category, interviewees most frequently mentioned: the lack of formal regulations in supporting WMC (1.2.5); a lack of access to WMC information (1.2.6); and the slow nature of the construction industry impeding WMC growth (1.2.18). The least mentioned phenomena included concerns about inhabitant safety or well-being due to the wood material (1.2.12) and uncertainty regarding the future lifecycle and aging of a WMC building over time (1.2.11).

None of the civil servant disclosed that they were personally uninterested in working with WMC projects (1.2.4), nor that they believe there are no marketing opportunities in using WMC (1.2.7). These categories exist because the civil servant have shared that other actors hold these beliefs about WMC (see: Section 5.2).

While the QCA coding framework provides a skeleton overview of the topics discussed throughout the civil servant interviews, it does not provide overarching themes that make linkages between the subcategories. And as per the QCA method, no segmented phenomena can be coded by two subcategories from the same major category. As such,

the coding framework alone does not specify when two phenomena are, for example, mentioned in conjunction to another. Moreover, the general nature the coding framework results in a loss of details shared by the interviewees. A deeper dive into the quotations is necessary to synthesize or devolve topics, and to provide greater meaning to the study.

5.1.3. Attitudes that contribute to WMC: benefits in project implementation

Analyzing the subcategories nested under the **1.1.1 Contributes to WMC Projects** main category revealed that civil servants see that contributing aspects of WMC results in advantages for various actors. These benefits also directly or indirectly benefit the municipalities, thereby fosters their desire to implement WMC projects. Excluded from this analysis is subcategory **1.1.16 Interested in WMC** which contains quotes related to personal support of WMC, and subcategory **1.1.17 Other** which contains scattered topics. A summary of these results are provided at the end of the chapter (see: Table 3).

The subcategory phenomena were topically grouped into three main themes: WMC economy, WMC technologies and WMC lifestyle. Overlap exists between these themes because some qualities pertinent to one theme produced synergies with qualities from another theme. As a result, three nexus themes emerged: technologies and economy, economies and lifestyle, and economies and technologies (see: Figure 3).

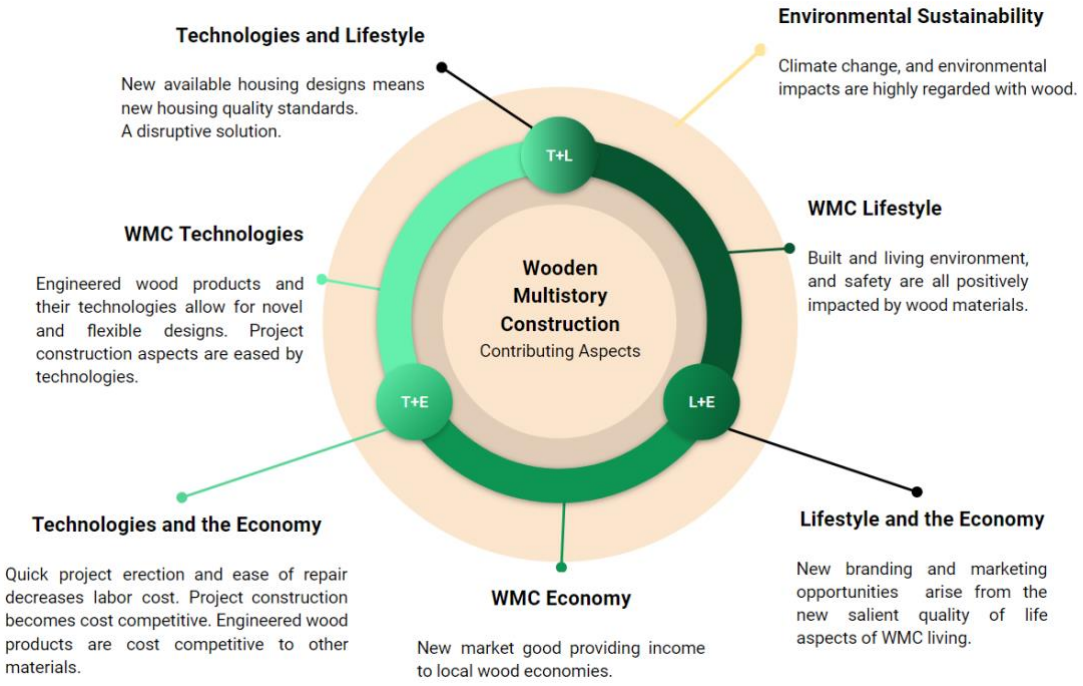

Figure 3 – The qualities of WMC projects which contributed to project implementation directly impact one another.

WMC Economy

The WMC economy theme groups phenomena that describe how WMC projects provide commercial benefit to various local and national industry actors. Phenomena under subcategories **1.1.3 Promotes new business opportunities**, **1.1.4 Supports local industries**, and **1.1.15 Encourages National Forest Sector** describe how actors along the engineered wood supply chain benefit from WMC project implementation. Civil servants discuss the importance of supporting these actors as a reason to engage in WMC projects.

Civil servants acknowledge that Finland's forest sector has been the primary reason for WMC projects development in Finland. When asked where the national motivation to implement WMC projects stems from, Finland's largest wood industry actors were mentioned:

> "*I think it's because, we have in Finland so much wood, and our biggest, wooden firms, like UPM and, Stora Enso they have launched, projects that carry out these wooden things [WMC]*."
>
> [Land Use Planning Expert 9]

The strong wood industry is a precursor for WMC development in Finland, but civil servants cite supporting the forest sector's economic development as motivation for implementing WMC projects. WMC projects are an opportunity to increase demand for the value-added 4rd generation engineered wood products required in WMC frames. This demand consequently increases demand for Finland's forest-based raw materials:

> "*I think, this is a sector, wood in Finland, should have been, let's say, made bigger. Or try to help the companies to grow in this segment. Because now, if you go in the port of [municipality A], you see the huge amount of raw wood. Why, the raw wood? Because the price is nothing. Of course, you should do something with it before you send it to the abroad. And of course, this is one of the easiest ways to do [it]. To create these companies and help the companies to grow, which are doing these, wooden constructions.*"
>
> [Development Director 10]

The importance of supporting smaller, local wood industries was also cited as a reason to engage in WMC project implementation. This was largely apparent in one municipality where all interviewed civil servants acknowledged that the establishment of local CLT

factories caused them to consider how WMC projects support these factories, as well as other WMC business ecosystem actors (e.g. architects, carpenters) who reside in town:

> "*But because we don't have had those WMC producers [nor] those factories. Now we have them, and we'll see [a] more active role from them. I'm sure about it. And, when it's combined also to the, promoting local economy when you buy from those local factory, it's good.*"
>
> [Development Director 2]

Civil servants are mindful of the economic benefits WMC industry actors will experience from municipalities supporting the implementation of WMC projects. While acknowledging their roles in supporting WMC projects they also shared what kind of benefits they envisioned their support would provide. One desire was that promoting WMC would increase the number of WMC industry actors and result in cheaper overall WMC construction practices:

> "*Of course, this Austria, they have used CLT technology many years […] But now we have got some new CLT factories here in [Finland] first one is Alajärvi now. And I think in some eastern part of Finland is another one. And third one is coming to Kauhajoki […] I think it [WMC projects] could be much cost-effective because there are also some other actors...*"
>
> [Mayor 4]

Another planner mentioned how encouragement of WMC projects helps improve the availability and development of new WMC business ideas and technologies:

> "*I'm [a] city planner and, when I put those [WMC] regulations to my plan, I hope to courage the business to [...] develop the business, develop new technologies for their business. I know there are many ways to do it and, I think, it has to develop on and on. [And with] every construction, [they have] a new opportunity to develop their own business.*"
>
> [Architect 1]

What can be discerned from the WMC economy theme is that civil servants believe implementing WMC project gainfully supports Finland's forest sector and local wood industry companies. Therefore, industry-side actors are taken into consideration when deciding to implement WMC projects. While the industry-side actors directly benefit from the municipalities engagement with their products and labor, municipalities benefit indirectly from the success of these industries. Civil servants also admit they hope

construction prices will be lowered through support of WMC, and hope for larger economic benefits from supporting local Finnish industries.

WMC Lifestyle

The WMC lifestyle theme groups phenomena that describe positive benefits that residents or end users experience from living within, or in proximity to, WMC buildings. Phenomena under subcategories **1.1.8 Safety**, **1.1.10 Built Environment**, and **1.1.11 Living Environment** describe how municipality citizens benefit from positive lifestyle aspects of WMC. Civil servants may see providing citizens with these benefit as part of their job description, which in turn contributes to decisions to implement WMC projects.

WMC projects are believed to provide benefits for local municipality citizens (e.g. residents and end users). How a municipality citizen interprets their built environment was especially important to one city planners. This planner recounted how they believe citizens benefit from the stress-reducing, aesthetic qualities of WMC projects, and they believe that compared to a concrete project, the health and well-being of neighbors is not compromised by the noise or dust created during the erection of WMC building:

> "*Urban environment usually adds your stress level so this wooden environment…would... relax…Reduce the stress.*"

> "*The construction time is short, and it's not so, noisy and dusty and unpleasant, construction site, than, with normal construction with concrete constructions.*"
> [Architect 1]

A city planner from a different municipality also described how the aesthetic qualities of WMC construction motivated them to push for WMC construction in their municipality because the aesthetic features created by the wood material could stand out alongside the cities culturally significant wooden housing district.

The unique aesthetic qualities which WMC offers the outdoor built environment is an advantage which citizens benefit from. Discussion on how citizens experienced life inside the home was also addressed. According to the civil servants, certain qualities of the end user's living environment are increase because of the wood materials. The wooden frames

are believed to provide better air quality within apartments, and the wood materials are also said to give a pleasant feeling to the inhabitant:

> "*I think that, the, air breathing is much more better, the quality of air is better*."
> [Planning Expert 9]

> *"This feeling or this…it's very, natural material, it sounds good, it feels good*."
> [Architect 6]

The safety of the end user with regards to fire hazards was also discussed. WMC projects frames are believed to be relatively more fire resistant compared other frame materials:

> "*These wooden blockhouses they are much more safe because they are not burning, anyway even though it's wood. In stone or if you speak about these steel-constructed houses because if temperature is going very high the steel will collapse but wooden it even don't burn so much.*"
>
> [Mayor 4]

From the point of view of the civil servants, the lifestyle benefits that citizen's experiences from WMC include aesthetic, health and safety aspects. The mention of these topics alludes to qualities which civil servants must consider on behalf of citizens when planning homes. It is likely that civil servants' consideration for aspects like fire safety are partially a consequence of formal regulations prescribed by national building codes. Civil servants did not explicitly voice that they indirectly benefit from the citizens improved lifestyles, but it can be understood as much given their job function.

WMC Technologies

The WMC technologies theme groups phenomena that describe how the engineered wood materials used in WMC projects allows adoption of technologies that ease building construction or repair processes for developers. Phenomena under subcategory **1.1.6 New Construction Opportunities**, **1.1.9 Increased Building Lifecycle**, **1.1.12 Construction and Renovation Ease** and **1.1.13 Novel and Flexible Designs** describe how civil servants perceive the WMC building technologies to ease or improve construction compared to those technologies used by the concrete dominated BAU construction regimes.

Civil servants mentioned how they believe the material technologies used in WMC is advantageous for designing the floor and space aspects of buildings. For example, WMC

is cited as being more flexible than concrete because the wood technologies allow for different size room elements. This is described to be a result of the standardized bearing walls in prefabricated concrete limiting the size and space design of a room, a feature engineered wood materials are not prone to:

> "*One is that, that old system is, really, it's so…you can't really change the size of the flat, because it has bearing walls between the flats. This wooden thing is much more flexible in that sense.*"
>
> [Architect 3]

Having flexibility with the size of a room can produces benefits for developers during construction. One civil servant shared an experience where the option to build small, tight room elements combined with the wood material frame resulted in a positive improvement to the construction projects overall engineering qualities:

> "*These small blocks and it's good for the structure when you build out of wood so it [the building] doesn't wave*[2] *or something, it's…The construction comes naturally so tight that when the houses […]are small, only one-room flats.*"
>
> [Architect 6]

The lightness of the engineered wood material was also described as allowing developers to construct projects at unfeasible or difficult sites. Specifically, it was mentioned that the lightweight frames permit construction of buildings on difficult terrain. This was mentioned as being especially valuable in a municipality where construction of new concrete buildings is hindered by poor soil:

> "*[WMC buildings] are light, and we have very bad soil in [our city] for the new constructions…the older, good ground is already used so that's very good that they are so light.*"
>
> [Architect 3]

The opportunity to build on a site which was previously unusable also indirectly benefits the municipality in question. Civil servants from this city mentioned strategic intent to increase development in response to the shortage of housing. Therefore, it can be understood that increased opportunities to construct projects would benefit them.

[2] It was unclear what the civil servant meant by "wave". They may have been referring to a quality related to the structural engineering of the design. For example, having enough walls in WMC projects ensures overall building stiffness (Stora Enso 2016, pg. 17).

The lightness of the engineered wood materials was also perceived to benefit developers during buildings repair and maintenance. While the prefabricated concrete elements of BAU methods require machinery to manage the heavy elements, WMC frames require these equipment to a lesser extent. Ultimately, that makes repairs more manageable:

> "*I think one advantage is that it's, wooden construction are repairable, you can repair them. It's easy to change the parts, for example and it's, usually it's more easy than, doing those kinds of, repairs in, concrete buildings* […] *It's also, much more easier, if you for example, if you do renovation afterwards, bigger renovation, you don't have to have all the equipment in the building site that you do have when, with so-called, normal, construction. I don't know if it's the right word, but it's kind of light, lighter. You can easily carry the building parts up to the floor where the reparation is needed and, so forth."*
>
> [Architect 1]

That developers can easily assemble and repair WMC buildings also provides indirect benefits to the municipality. This same planner who discussed the benefits of being able to repair a WMC building later discussed how they ultimately looked forward to buildings which last longer than the standard concrete project because of the reparability:

> "*Wooden buildings are, easy to repair. They need maintenance, and they need repair, but if you do that, often enough, and take care of your building, it definitely has, many decades' life cycle. And, I hear these arguments that concrete buildings…they last for, a hundred years but, we know that there are, concrete buildings that, their age is just, 30 or 40 years they are just rotten. And you have to, they are not easy, it's not easy to repair them, you have to tear them down and, make new facades and, it's very, difficult to repair them. So I think, wooden buildings are doing okay. They don't last forever, but, you can repair them*."
>
> [Architect 1]

From the advantages discussed in the WMC technology group, it can be discerned that civil servants perceive there are construction related benefits to building with engineered wood products as opposed to concrete materials. Developers can build optimal building designs on difficult sites, and are able to repair buildings with ease. While these advantages directly benefit the developers on-site, civil servants may foresee how these advantages indirectly benefit their municipality. For example, by having demand for new residential buildings satisfied with projects at previously unfeasibly sites, or projects with longer lifecycles.

Lifestyle and technologies

The lifestyle and technologies theme joins together phenomena that describe how the WMC technologies used in projects—particularly the capacity for new and flexible designs—transforms the current-day lifestyle expectations of the residential housing market to emulate qualities described in the WMC lifestyle theme. Phenomena under the subcategory **1.1.14 Quality Standards** describe how WMC is perceived to shift housing quality standards. This is a welcomed trait contributing to WMC project engagement.

Discussion about the civil servants' apparent disillusionment with current design quality standards was expressed openly in several interviews, along with the notion that WMC technology systems can provide higher design quality standards:

> "*I think for example this CLT system with, whole…space, elements, it can be architecturally, interesting and to bring some good quality, what we don't have just nowadays.*"
>
> [Architect 3]

It was also remarked that if the higher quality design aspects associated with the WMC projects can enter the market and compete with the current-day lower quality home designs, then this would disrupt the housing market standard:

> "*WMC, I think it's one good way, to get the quality higher. So they will, be on market, competing with quality, buildings with WMC buildings.*"
>
> [Development Director 2]

To civil servants, the market competition would allow improvements of both BAU and WMC projects. Civil servants seem to perceive that the innovative competition which WMC construction technologies brings to the residential housing market might result in a disruptive solution to the poor quality in the current day standardized concrete regime:

> "*We are still, building in same, constructions since early 70s, this is called BES*[3] *system. It's very rigid, it's very not flexible, not…and I think it's a very old fashioned, way to build. I hope that…we would have a better concrete structures and also these new wooden structures, I think they're very superb so I really hope that, we will have these alternatives*."
>
> [Architect 3]

[3] The concrete BES system standardizes concrete elements and joints so finished parts purchased from suppliers always match one another regardless of the distributor (see: Laukkanen 2018).

To the civil servants, the desire to increase quality in housing standards likely ties back to the end users who are experiencing the better lifestyle aspects associated with the competition of new housing market standards. Just as with the WMC lifestyle theme, no civil servant outright stated that they indirectly benefit from the citizens improved lifestyles. It is assumed as based on the conversation. What civil servants did mention is how they hoped supporting WMC projects would provide high quality lifestyle choices and indirectly benefit construction industry actors—both BAU and WMC—as they are forced to compete and innovate in the market.

Lifestyle and economy

The lifestyle and economy theme describes how the positive aspects of WMC living create salient quality of life experiences which can be marketed or branded by different actors to boost consumers' product awareness. Phenomena from subcategory **1.1.5 Branding and Marketing Opportunity** describe how WMC could be used as a form of branding, and how this marketing might benefit the municipalities or other actors. The marketing potential is a large motivator for civil servants to engage in WMC project implementation because municipalities can take advantage of this facet to promote their city.

Civil servants discussed how WMC projects could be used by their municipalities to send a message about issues which are important to the actors around them. For example, one civil servant believes that the WMC projects could serve as a conduit to attract other actors to reside in their city because the project sends a message that the city leaders cares about sustainability-related quality of life issues:

> "*I think there is, interest to promote [the city] as, one of these smart and clean, cities. I think that's very, trendy now, and it's something that the, city mayor would like to see [...] It would benefit the business and marketing the city. So that […] that could be, a reason to, promote [city] with those kind of, project, like these wooden building projects.*"
>
> [Architect 1]

Given the various other advantages discussed by civil servants thus far have constituted benefits which directly benefit other stakeholders, it seems that branding and marketing opportunities are the only direct benefit which municipalities might derive from WMC. One unique opinion also emerged related to the marketing aspect. One city planner voiced

that the responsibility of marketing and branding did not fall on the municipality, but rather the industry actors:

> "*So, I think then there should be both, concrete industry and wood industry. They should marketing their materials so, what's good in them, so that the [building] companies would take them more in use.*"
>
> [Architect 8]

While this city planner did see the value of marketing and branding, it was more in a market context. They believed that private stakeholders or other agents should be the ones to brand the qualities of materials.

The lifestyle and economics aspects of WMC encompass the lifestyle benefits of WMC being used as a competitive advantage. In the case of the municipalities, the promotion of the "trendy" salient experiences might make the city a more desirable placed to live, thereby increasing overall city residency. Civil servants also see how industry actors can benefit from branding and marketing aspects to garner a competitive market advantage.

Technologies and economy

The technologies and economy theme joins phenomena where engineered wood technologies directly impact the economic aspects of a WMC project, and thereby benefit developers. The phenomena under subcategory **1.1.7 Price Competitiveness Aspects** included scenarios where financial aspects of WMC buildings were kept competitively priced due to the wood construction technologies.

As described by the WMC technologies theme, the lightness of the engineered wood makes aspects of construction projects easier to build. This ease translates to needing less heavy machinery on site, and faster construction assembly times. Ultimately, this decreased the number of man-hours spent at a project site and reduces the labor cost:

> "*One advantage is that, building in wood is very, it's very quick. They can, just put a layer after layer on the construction site after days or weeks, and they don't have to wait for the concrete, to get, dry. That's one of the, reasons why it takes so long time to build, with concrete. Because they, after building every floor they have to wait for the concrete to, get dry. So that's one advantage*."
>
> [Architect 1]

> *"One of the, a really good thing is that it's, the time is shorter, to build. Especially when we are building in, the existing area [infill] [...] kind of financial way it's also very good"*
>
> [Architect, 3]

Another civil servant discussed how the purchasing the manufactured engineered wood products from a local factory source ultimately end up costing developers a price akin to that of a BAU project:

> *"In the very city centre here [BAU projects cost] are, over 5,000 euros per, 1 metre [to build]. So with 5,000 euros, you can also build a WMC building here, 400 metres from the very city centre…So, maybe there will not even be so much, difference between prices, although it's little higher but it's not higher than in the very very city centre […] Because we have these factories nearby so there's more production, and when we have more production then the prices will go down*."
>
> [Development Director 2]

Although this civil servant primarily discussed their belief that economies of scale will eventually reduce the cost of engineered wood products, under the current-day scenario the civil servant still perceives WMC project development to be cost competitive to BAU project development. Focus is on material location being the largest influence of price. This is attributed to the production cost of the engineered wood products being cost competitive compared to the cost of other BAU frame materials.

Environmental Sustainability

The environmental sustainability theme is an overarching mechanism that governs all aspects of conversations related to WMC. As stated in the contextual background, the largest desire to change BAU construction material practices in Finland is largely a question of promoting means to achieve sustainability goals that benefit society at large. The phenomena under subcategory **1.1.1 Sustainable Development** and **1.1.2 Climate Change** contains accounts of the larger societal role of WMC to support sustainable development and climate change agendas.

Civil servants discussed the benefit of WMC to reduce CO^2 emissions through carbon-capture, the general role of wood in mitigating climate change and fulfilling an environmental agenda, and how they personally see wood as a sustainable material:

"*What's relevant in, building, in wood, it's, nowadays, because of the climate change this, it's very important to, have ways to diminish the CO^2 emissions.*"
[Architect 1]

"*When it's combined to, climate change, it's better, I don't know but maybe it's better to have WMC buildings in, from environmental point of view.*"
[Development Director 2]

"*And somehow, at least in Finland like you mentioned, we have this, woods everywhere and it's an ecological thing to build from the wood.*
[Development Director 10]

Overall, not much else was shared regarding the topic of sustainability, and it is implied based on the context of conversations to be a benefit for society.

Table 3 – Summary of main themes and advantages described by civil-servants as contributing to WMC.

Themes	Subcategories	Actors	
		Directly Benefit	Indirectly Benefit
WMC Economy	1.1.3 Promotes new business opportunities 1.1.4 Supports local industries 1.1.15 Encourages National Forest Sector	WMC Industry Forest sector	Municipalities
WMC Lifestyle	1.1.8 Safety 1.1.10 Built Environment 1.1.11 Living Environment	End users Residents	Municipalities
WMC Technology	1.1.13 Novel and Flexible Designs 1.1.6 New Construction Opportunities 1.1.12 Construction and Renovation Ease 1.1.9 Increased Building Lifecycle	Private Developers Municipality Developer	Municipalities
Lifestyles & Technologies	1.1.14 Quality Standards	End users Residents	Municipalities WMC Industry BAU Industry
Lifestyle & Economy	1.1.5 Branding and Marketing Opportunity	WMC Industry Municipalities Forest sector	End users Residents
Technologies & Economy	1.1.7 Price Competitiveness Aspects	Private Developers	Municipality Developers
Environmental Sustainability	1.1.1 Sustainable Development 1.1.2 Climate Change	Society at large	Society at large

5.1.4. Attitudes that hinder WMC: unpacking barriers to WMC

Analyzing the phenomena under the **1.2. Hinders WMC Projects** main category revealed that the hindrances in implementing WMC projects were often caused by market entry

issues. Civil servants rarely discussed the shortcomings of the engineered wood materials as a factor hindering project development. Instead, they primarily cited aspects related to a poor operating environment which coupled with limited government interference triggers risk and a high cost of WMC project implementation (see: Figure 4).

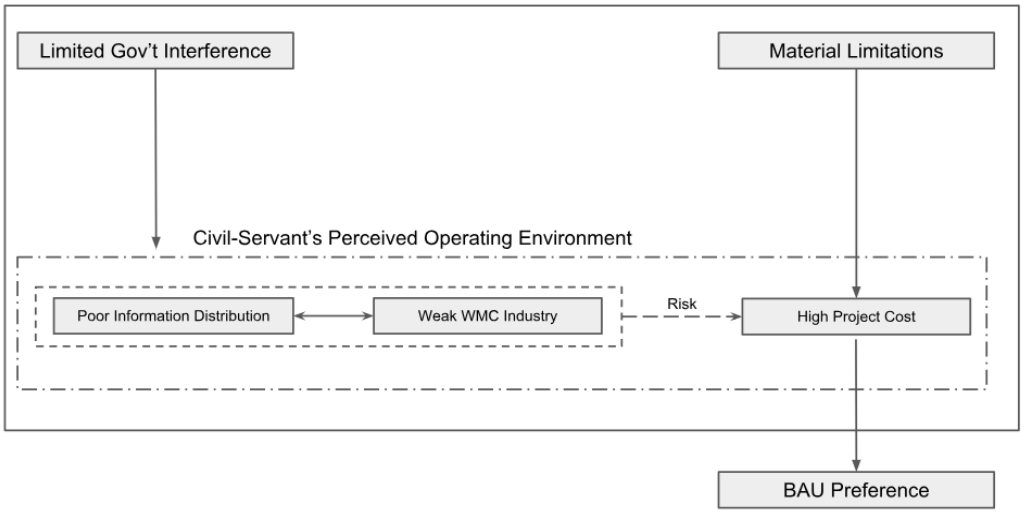

Figure 4- Limited support for WMC projects is seen largely a result of issues triggering high cost of WMC erection. These issues include a slow-to-develop industry with limited access to information and poor government support.

The perceived operating environment: a weak WMC sector creates project risk

Most of the WMC implementation barriers discussed by civil servant revolved around qualities ensuing from the WMC industries weak presence in the construction sector. The overall failure of the WMC industry to develop a presence is attributed to the strong presence of the concrete industry. The weak presence results in few WMC actors, which in turn is cited as a cause of project development risk and high cost.

As discussed in Section 2.2, concrete has been the primary frame material in multistory construction in Finland since the emergence of the prefabrication technologies permitting quick and easy construction to satisfy urban housing shortages. In the opinion of civil servants, the business as usual concrete regime has effectively ensured the slow development of WMC industries for various complex reasons. That the concrete regime was developed in the 1970's alongside a standardization committee is regarded as a challenge for the WMC industry to overcome:

> "*The field of construction companies in Finland we have, about five big companies, and they are very old-fashioned. They build concrete buildings,*

> *they have their, element factories and their systems. In fact the systems are quite common they have been made, together with Finnish, standardization committee in the 1970s and they all use the same systems. And they are very hesitant to do anything new, for example this wooden [WMC]. And mainly there are new companies coming up but they are so small.*"
>
> [Planning Director 11]

New competitors (e.g. WMC construction) naturally come across challenges when entering already established markets (e.g. concrete dominated construction regime). These challenges–commonly referred to as barriers to market entry—limit competition in markets and sometimes result in monopolistic markets (Karakaya 2002). That the BAU construction sector operates around the concrete industries legitimately established standardization process has insured the concrete industry a pseudo-proprietary advantage and a superior production process advantage over other material industries seeking to compete in the construction sector. Karakaya would dub these "firm specific advantages".

Further complicating the issue is the impact of the aforementioned "five big companies" perpetuating the standardized BAU practice in the face of the "small" new companies willing to use a different method. The reason why larger firms are disinterested in changing from current BAU method is that it will not profit them to do so:

> "*If they [developers] are not 110 percent sure that it [a project] will succeed [in construction] they are not doing it because, they are by the way now doing very good business, and they are getting a lot of money by making it of stone…Why to change a good system to the other one?"*
>
> [Mayor 4]

The limited interest from the largest construction developers also lessons opportunities for smaller WMC industry actors to compete within the construction sector and manifest projects. Moreover, if finances alone determine the likelihood of a large-scale developer's cooperation, then what happens when municipalities engage in non-BAU projects? Where cities have attempted to negotiate with firms to develop WMC projects, the large-scale developers have generally met the cities with resistance. One tactic is to simply deny project proposals during negotiation phases:

> *"But we are telling, we have to build something like this, companies say no, because nobody wants to buy that. So this is quite really, a long process how to effect or how to change things.*"
>
> [Architect 8]

In this scenario, the developer uses the desires of the end user to justify their decision to not to engage in project implementation. This may be a strong point of leverage given the discussed presumption that civil servants work to serve their municipality's residents. In more extreme cases, the role of lobbying was cited as a tactics of resistance. And lobbying is used not only by the large developers hoping to maintain BAU construction projects, but also by the concrete industry looking to continue securing their market position:

> "*They are lobbying quite a lot the building industry and, whenever we talk about, and make initiatives to promote wooden structures, there's always still builders and concrete buildings and building constructions lobbying their idea that they are, as sustainable, they have made new, development and, although they are quite, the same, in the decade after decade. So, the lobbying…because they are, employing a lot of people, it has an effect on the politicians of course, and the voters. So the change is, quite slow.*"
>
> [Development Director 11]

In both negotiation and lobbying tactics, developers use the needs of residents (i.e. desires and jobs) to promote their agenda—an agenda which civil servants believe is based on financial self-interest. However, under what circumstance does finance impede developers from taking on projects? The relationship between developers and investors hints at why developers choose to align themselves with the BAU methods of construction. The first WMC projects in Finland resulted in limited investor interest, which was seen to impact the continued attention of one large scale Finnish developer:

> "W*hen I was in [developer company] they, told me that they have some 8 or 10 [WMC] projects, and just when they, learned the case, they stopped those [WMC] projects. So, the first one where catastrophes in that time, some 20, 15 years ago and the last ones it was okay. But no one, ordered those projects. So, it's not about just construction, industry, there are also investors and so on. So if there's no, demand for it, it's not so easy*."
>
> [Planning Expert 9]

The role of investors in funding developers to adopt WMC projects is apparently more important to a developer than the firm's own capacity to learn how to erect projects outside

of the BAU method. Developers have been able to implement new methods and successfully carry out WMC projects, but financial investment plays a role in project development. Therefore, consideration must also be given to the role of investors in the continuation of BAU practices.

Even though the WMC industry has been attempting to establish itself in the construction sector for 20 years, entry has been limited and has resulted in a few WMC actors in the market. The limited number of market actors has manifested into several perceived barriers to WMC project implementation. To civil-servants, these barriers appear as risk during multiple stages in a WMC projects planning and construction phases.

At the preliminary stage of a WMC project, the relationship between WMC planners and the limited number of WMC actors is deemed to be fraught with risk. From the start of a project, it must immediately be decided whether a design will implement a wooden frame or concrete frame. This is due to the difficulties in changing construction system between the BAU concrete method and those used in WMC projects:

> "*You can't design similar houses and, afterwards to compete, is it made of concrete or is it made of wood because the system is so different so you have to decide it before you start to design it.*"
>
> [Architect 3]

The choice between one construction system and the other is worrisome because you then must ensure that whatever the plan be, someone can carry it out. If a designer can be found to create a WMC plan, then the next phase entails putting the design up for bid. Typically, developers compete with one another for the rights to build the design during a bidding process. The small number of WMC developers means there is a risk in not finding anyone to bid on the WMC project:

> "*There are just very few companies which offer that bit, it's always risk, first, because you have to already design them to be wooden construction, and then you have this competition for who will offer to build it."*
>
> [Architect 3]

Civil servants are aware that the limited number of actors does not extend to just designers and developers, but also to other WMC ecosystem actors who manufacture the engineered

wood products. For civil servants, this creates doubts at the stage where the developer has taken on the WMC project to erect it. The municipality must trust that the developer can carry out the project as promised, but because the WMC value chain has scattered suppliers and limited subcontractors, there are doubts that the assembly will go smoothly:

> "*There are also not so many... firms, companies which make these things so, there's also the question, who is responsible for the thing. The company who brings the space elements or, is the other company…because normally, these concrete factories are owned by the same companies it's, this is not so obvious question [in WMC]*."
>
> [Architect 3]

Some civil servants perceive that they themselves must consider the question of who will ultimately be responsible for the various aspects of a project being executed seamlessly. These risks at multiple project stages are likely intensified by previously strained scenarios with developers, as admission of frustrations during projects were shared. For example, one city planner shared a situation where a developer had proposed a WMC project during a municipal design competition, and after winning the competition reneged and instead offered to erect a concrete building:

> *"The building companies, [said] they are ready to use wood in this area. And it's quite strange if you have competition about wood-constructed multi-level houses, and when they won, so they want to build concrete buildings. It's like really frustrating."*
>
> [Architect 8]

Another example of the problematic communication between the two parties was given by a different city planner:

> "*We [city planning] try to think as much as possible and, and as a group. So that we're building or designing a, area, we consider all this [for the end user]…So that this works, as best as could, as a group usually, and then when the builder comes, he only thinks about himself.*"
>
> [Planning Director 7]

In this context, the civil servant was alluding to the municipality's task to design plans which consider the end users experience. This interviewee points out how the "builder" (i.e. developer) comes and disturbs this group planning process with notions that only considering aspects of planning which would be most useful for them. This is especially

powerful when considering that developer tactics to resist non-BAU construction methods are under the guise of being in the best interest of the end users and residents.

In smaller municipalities, the limited number of WMC actors presents an even greater risk because of the impression that developers are not interest in working with projects in smaller cities anyways. Additionally, when confronted with a complex plan that is non-normative (e.g. WMC), developers are even less likely to build in a smaller municipality:

> "*If you are in [small municipality], which is still a city, it's hard to get builders. So if you make the plan really tight, what you can do, what you're able and what you must do, it cuts certain companies off, and then it makes it even harder and harder to get these [WMC] started. So…if you set in the plan that it must be a wooden building, then, most of the builders can't do those. And if, [wood developer] has too many projects at the moment. If they can't start it, and there is nobody else who want to do it, that means that no one is starting it. So that's, one thing which the [smaller cities] must be, let's say, open with the plans, what you can do and what not*."
>
> [City Development Director 10]

Working with a limited number of WMC actors creates concerns for seamless project implementation, and civil servants feel that they are occasionally at the mercy of developers. Coupled with previously difficult experiences, civil servants seem to desire smooth working conditions. For example, there was an admission of the necessity to improve communication with development actors at various project stages, going even so far as to state that the city administration may require outside help in this endeavor:

> "*This might be the way to make it, more information and, conversation with them [developers]. Maybe now we are starting this new city plan so via this project we have possibilities to have more conversation and maybe we need some more help also for that."*
>
> [Mayor 4]

Altogether the uncertainties in finding actors capable of designing a wooden building, of bidding on WMC plans, and of managing the project manifests as frame of mind that WMC projects may become stonewalled at any time. In short, the limited number of WMC actors hinders the decision to take up a WMC project in the first place. Yet from another perspective, one civil servant mentioned the difficulties in motivating larger developers to

participate in WMC project construction due to the limited number of projects implemented throughout the country:

> "*So now we are making this very few percent is by wooden blockhouses. Maybe in the future if you double it triple it so of course these bigger actors will come also to play this game…But it takes time.*"
>
> [Mayor 4]

A chicken and egg debate has formed in the minds of the civil servants: the lack of WMC actors hinders the number of WMC project implemented by municipalities, and the limited number of WMC projects implemented limits the number of WMC actors developing in the sector. Whether this paradox is real is uncertain, but contradictory feelings are shared.

As a final point, civil servants mentioned how the weak WMC industry also underpins the high cost of WMC projects because the limited number of WMC actors means a more expensive construction method:

> "*Of course, disadvantage is that it's more expensive, it's not much more expensive but nowadays because there are not so many people dealing with that business, that tend to have, keep the prices high. There's not enough companies in the business to get the prices down by concurrence*."
>
> [Architect 1]

Just as how the standardized concrete construction method causes market entry barriers for WMC industry actors and a firm advantage for concrete industry actors, the limited number of WMC industry actors in the face of many concrete industry actors results in a market entry barrier known as economies of scale (Karakaya 2002). While the term "economies of scale" is not used by civil servants, the concept of economies of scale—having few actors leading to higher product cost—is shared by a few interview participants. Altogether the limited number of WMC actors, the manifestation of few project, and the high cost WMC projects are all mentioned factors that result in the choice to implement BAU projects rather than WMC projects.

The perceived operating environment: poor WMC information distribution

Another set of frequently discussed barriers to WMC implementation were the phenomena exemplifying the poor distribution of WMC information within the operating

environment. A lack of WMC technology information—stemming primarily from inadequate accessibility—results in a thin understanding of how WMC technologies function. There is also little information about how citizens regard WMC, which is relevant because they are seen to possess influence over the housing market through consumer choice. This lack of information elicits uncertainties concerning WMC support.

Several civil servants admit to personally lack information about WMC. For example, when civil servants were asked how WMC technology information could be gathered within their municipality, responses differed broadly. Channels for gathering WMC information were acknowledged, but the overall sentiment revealed challenges accessing these channels. One interviewee described the overall plight of access best:

> "*I think there is quite a lot information about wood technologies at the moment. You just have to know from where you can find it. And quite often, I think, people who should go and visit and learn more, they don't do that.*"
> [Architect 8]

In other words, sources for accessing wood technology information exist but discerning what those sources are and engaging with those sources are different questions altogether. This conclusion is supported by the variety of responses given. For example, on civil-servant said finding sources of WMC information was generally hard to determine:

> "*Yeah [WMC information] it's, in fact I think it's quite, difficult to find. Maybe the lack of, modularity and systems is the reason because they are, in a way it's quite dispersed the field of construction and systems and, every company has, its own, brand or systems.*"
> [Planning Director 11]

The scattered availability of industry technologies creates difficulties for determining which source to approach for information. The same civil servant goes on to say that on a personal level, visiting sites is their most valued method of learning new information:

> "*Speaking of myself I think that I, for me, the most important is to visit sites, not just the finished building but during the construction*."
> [Planning Director 11]

The civil servant makes an emphasis that visiting construction sites for information is a best practice that suits their personal style. This hints at the notions that going out to find WMC information is an individualist approach as opposed to a normative standard. The need to have personal engagement to access WMC information came up in other conversation, too. For example, one interviewee pointed out that despite their being various WMC information sources, one must be active in pursuing them:

> "*If you are active yourself you can find it [WMC information]. I think, it depends on your own activity…we have those kind of, for example, Wood Info, Puuinfo […] I don't have enough time to, follow all the research that is done. It's more, what information do I get in seminars for example. But there are, quite many, seminars about wooden construction.*"
>
> [Architect 1]

In this example, the limitation is not caused by the scattered channels but rather the civil servants own accountability to access the channel. Seminars may be aplenty, but time is not. Time constraints were frequently stated obstacles to accessing WMC information. A similar experience was shared by a planning director who was currently engaged in a WMC project. They described having identified a WMC site in a nearby town to visit and learn from, but admitted they had not had a chance to travel there due to time constraints.

The multiple conversations about needing to acquire more information about WMC also imply that civil servants have lacked exposure to wood construction in their education. Given the BAU preference for concrete construction in Finland, this does not seem farfetched. The idea is also supported by the fact that only one civil servant mentioned having had a previous education which was characterized by wood construction methods:

> "*I have studied in Germany and it's more popular in Germany the wooden construction than in Finland at that time [when I studied]. Nowadays they are quite similar…and I'm interested always to build and make with wood and, I have read, the information*."
>
> [Architect 5]

Despite their education, this city planner mentioned their desire to work with wood as being their prerequisite to seeking out WMC information. At the end of the day personal motivation seems to play a role in taking up WMC projects. One city planner discussed the topic of motivation in seeking out WMC information sources as follows:

> "*It's funny but it goes that…at first we to have, someone to, support this kind of development and someone to demand these kind of solutions, so that we as planners, have the, need to educate ourselves.*"
>
> [Architect 1]

In other words, civil servants will not typically seek new information on construction and development techniques unless there is a need to do so. This belief seems supported by the quote discussing how civil servants will find information on WMC if they are active, and the admission of the city planner who had a personal desire to go visit a WMC site because of their current engagement with WMC projects.

It seems that the limited distribution of WMC information is in small parts due to the scattered sources making it difficult to find where to turn for information. But more than anything, civil servants also lack the time or motivation to learn about a new, non-normative method of construction. Accessing WMC information comes from the "need to educate", otherwise it comes from personal interest. Ultimately, the lack of access occurring means that there is limited WMC information in circulation.

The lack of WMC information, spearheaded by the limited means to bridge the civil servant knowledge gap, has become a source for uncertainties in WMC project development. These uncertainties may create doubt that later hinder the implementation of a project. Without the appropriate technology information, skepticism arises regarding how the wood technologies will age. One civil servant shared their uncertainties as follows:

> "*I can't tell, I'm still not very confident if it really works the system of, technology itself. So does it work actually the same way the old log construction works, of like, letting the moisture go through and so on. If they really done everything to consider all these facts. I'm not sure at all. But I think we only know after 20 years if it really worked."*
>
> [Planning Director 7]

Doubts still exist about whether the technologies have been well tested, and whether the technologies will hold up to the test which have been made. The only certain method to determine this is to see how the project ages post-construction. That humidity was the exemplary topic of uncertainty mentioned is a reminder of the health and safety decisions

which civil servants face when considering frame-material choices. Being uncertain about these aspects of a building will certainly create doubt about project implementation. But other less serious topics of uncertainty were likewise discussed. Another civil servant mentioned uncertainties associated with the woods capacity to hold up aesthetically:

> "*We don't know because they are very new these blockhouses. What it looks like after 10 years 20 years and so on what will happen then*."
>
> [Mayor 4]

Because of their uncertainties, the interviewee shortly thereafter remarked that more research should be implemented about WMC building lifecycles. This desire to have more research reaffirms that there is still limited WMC information, as the civil servant contemplates research areas that they would like more information on:

> "*What we need is this different kind of research work. […] If it's now let's say maybe 3–4 percent blockhouses maybe less are made by different kind of wood constructions. If you'd like to make it 10 percent or even more 20 or let's say 50 you need so much different kind of research work starting from how to build house.*"
>
> [Mayor 4]

None of the civil servants voiced that the limited knowledge or access to WMC information was a direct hindrance to WMC projects. The limited access to information was discussed under more matter-of-fact terms. Yet if one civil servant mention they have uncertainties regarding the wood technologies this could imply others have similar doubts. That doubts would translate to perceive riskiness which eventually hinders a WMC project from being implemented is also feasible. This is supported by one civil servant's discussion on how prejudices still exist due to earlier studies on WMC:

> "*I have, read some report…it was quite a technical point of view. There's nothing, [in it] that we, could now discuss. But I think, at the beginning there was costs and fire safety and, the belief of that, is there, that house still standing after 50 years. Those were the facts that were discussed in early wooden, so I think, most people remember that*."
>
> [Land Sales Expert 9]

In this scenario, insight into the original uncertainties regarding WMC were shared. While the civil servant does not personally believe that these topics are still relevant today, they

do acknowledge the persistence of prejudice regarding those uncertainties today. While not directly implying that a lack of information hinders WMC project implementation, this statement does outline how hindrances due to misinformation persist in the operating environment, although perhaps they would not if the new information on these topics was more readily available or accessible. After all, this civil servant does not believe that these issues remain today, implying they have accessed some sort of information to the contrary.

While the limited information of the technical aspects of WMC was one major topic pertaining to poor information distribution, another topic of limited information is the housing desires of the municipality citizens. Municipality citizens entail the end users which currently reside in a WMC building, and the resident who may or may not move into a WMC building. Many interviewees stated that their municipality does not conduct research related to citizen housing desires regarding WMC:

> "*We have also the, small department which makes some kind of studies and, on these kind of things but…I haven't noticed that there has been any, which have studied or researched the wooden structure-, construction and end users', attitudes on that.*"
>
> [Planning Director 11]

Only two civil servants mentioned they had personal contact with WMC end users. What was more frequently shared were experiences from the legally mandated *osallistumis ja arviontisuunnitelma* [Participation and Assessment Plan] *(*OAS*)* zoning process (see: Ympäristöministerio 2007). After local detailed plans are drawn, this process invites all actors (e.g. residents, neighbors, local private industry) to review and give feedback on any aspects of the plan. It was in relations to this process that civil servants discussed the end users and residents' desires, and the majority civil servants held the belief that the end user and residents were generally apathetic to, or unreliable in providing feedback about their desires. For example, one architect said:

> "*We had always this problem with the to-be inhabitants. 'Cause nobody's interested in our business, before they actually start to think, 'I might move in here'. And even if they see an article in the newspaper […] They know [about the WMC project], but they still haven't even considered moving in. So, we have not so much contact with the to-be inhabitants or residents.[…]As I told, it's very difficult because, end users don't show up*

> *before, only after we've done our plan. It's very very rare that we would actually need the end user, before we have the plan […] To tell the truth we pretty much know what the answer [they give] is. It's complaints about certain things, the plot is too small and why do you make plots so small.*"
> [Planning Director 7]

This opinion first highlights that it is difficulties to find end user because the municipality is unable to predetermine who will live in a new building. Then, because a resident does not even know that they themselves are a future end user of the plan in question, they are apathetic about participating in the public planning process. And lastly, if the end user did participate in the public planning process the feedback received might be unnecessary or obvious. Another architect mentioned similar thoughts throughout their interview:

> "*Not in that sense that we would be in straight contact to those people who are going to live there [in WMC]. Because it's quite hard to be in touch with those people if the area is totally new. You don't know who those people are going to be. […] If you are interviewing them, quite few people can dream, or give answers that they would like to have something new if they don't have any experience of that […] That's why, when we have new competitions and we have illustration pictures and we have these public meetings and we give this area and what kind of housing there would be, so we create new dreams.[…] But I think quite many people, that there are quite few people who are interested to give feedback at the moment.*"
> [Architect 8]

The overall feeling is that locating end users is difficult, and that end user perspective on city planning is less reliable (presumably than a city planners), so the purpose of the public planning process is to give the end users new dreams. Yet, the same civil servant also admits they believe most citizens are not interested in giving feedback at meetings. But this does not mean that the civil servants are against receiving feedback from residents about their desires. Instead, the perspectives on end user apathy to provide information regarding their living desires are colored by previous experiences. One planner says that it is "fortunate" when residents share their desires, likely because it happens so rarely:

> "*And sometimes when we have, good luck they are eager to tell, what kind of new buildings, they would like to see and where they would like to live."*
> [Architect 1]

Still, most civil servants corroborated that general contact with citizens during the planning process phase includes negative feedback as opposed to anything else:

> "*And mainly our, conversation with, end users or neighbours or so on, it's more negative, response*."
>
> [Land Sales Expert 9]

> "*We have this open internet system. You can ask what you want to ask and, we can send you comments. Maybe there are something but it's not that official, let's say, and normally it's not ever positive. It's always negative."*
>
> [Development Director 10]

The overall discussions during the OAS planning process has not been a reliable method to communicate with the end user or residents about their housing desires, as the process seems to elicit more negative feedback than useful suggestions. One civil servant offered commentary as to why end users might be apathetic or unwilling to share experiences about their desires— because of cultural taboos surrounding this type of discussion:

> "*If you would say it loud because I think nowadays I haven't heard any interviews in the newspapers or whatsoever who are living there in this kind of houses, how do they feel…And this is I think more or less a taboo. You are not discussing about these matters."*
>
> [Mayor 4]

Another civil servant pointed to the role of rent-seeking as a culprit. Those who own apartments to rent them are not interested themselves in the quality of the neighborhood or apartments themselves. Then, those who rent do not plan to spend much time in the apartment and are also apathetic about what happen there in the long-term:

> *"Maybe they [apartment owners who rent] don't care that much, because it's only for financial instrument, and then, those people who are living there [in rented flat] are not doing this for many years. So their interest to develop the area or have the discussions with the city, it's not that high"*
>
> [Development Director 10]

The hindering aspect of having limited information about citizen housing desires comes from the civil servants own belief that the citizens are valuable stakeholders in effecting housing market changes:

> "*I think the residents' opinion have, is, that's one driving, force.*"

[Architect 1]

> "*Of course if people say "we are not moving to the stone house" so it's changed in one night, but maybe they are not saying so.*"
>
> [Mayor 4]

> "*[If] our citizens [--] they, tell that, 'We want more, areas like that, please have more those', then our politicians and people who work here in municipality, get to hear that yes that's good choice*."
>
> [Development Director 2]

A limited understanding of citizens housing desires eventually creates limited chances for civil servants to indorse the use of WMC projects over BAU buildings. On one hand, the consumers' choice is perceived as being able to shift the market standard through their purchasing power. On the other hand, the nature of the municipalities' role to serve the people causes citizen demands to resonate with politician and other key city planning figures tasked to serve them. In both scenarios, the end user has ample leverage.

Meanwhile, when looking back at the hindrances caused by the WMC weak industry position, recall that BAU developers often cited the resident's desires as reasons for not shifting from BAU practices. As other actors leverage citizens' needs, a municipality's limited knowledge of citizen desires may be impacting planning and development conversations. For example, one civil servant discussed how end user desires are currently interpreted by real estate agents through market sales data, and the shortcomings of this method of gathering data for the use of planning in their municipality:

> "*The building companies, so they get this information from those people who are selling the apartments [real estate], what people who are buying new apartments, what do they want, and what kind of apartments are selling well. Which is, quite bad way as well because, in our strategy and in this area we wanted that there would be new kind of housing and new kind of apartments and new ways to live in the city. And it's often, building companies and this feedback they are getting from those people who are selling apartment is quite narrow, as well those who are investing money to those apartments. And it's not actually giving anything new*."
>
> [Architect 8]

This is a criticism towards the types of distortion which occurs regarding citizen housing desires. In this same way, the role of rent seeking was criticized earlier because it becomes

a market driver based upon unidentified desires. Ultimately, misrepresentation of citizen housing desires can lead to poor development planning between the public and private sectors. Situations like this serves as further evidence about how limited WMC information within the operating environment causes WMC project hindrances.

Material limitations and project implementation cost

Civil servants seldom mentioned technical limitations in the engineered wood materials causing hindrances to WMC project implementation, but a few examples were given These included the wood materials inability to muffle sound, the vulnerabilities associated with the materials lightness, humidity challenges, the requirement of a unique sprinkler system, and some project designs restrictions caused by the wood materials. Concomitantly, some of these restrictions impacted financial aspects of the project.

The lightness of the wood material used in WMC were cited as having technical inefficiencies during the construction phase. For example, the lightness of the wood may put the project at risk during windy scenarios, although it was not made explicit how:

> *"Except, in harbor area because they [WMC projects] are too light. There was a problem in Jätkäsaari because it was [laughs], going to the wind*."
> [Architect 3]

Humidity was also briefly discussed, although not under the premise that wood materials are more at risk than other materials for humidity damage. Rather, the question of humidity came up because humidity is a major issue of concern throughout general construction practices in Finland. It is an issue irrespective of the material:

> "*[Humidity] it's a challenge for all materials but there are different challenges when it's a question of wood and when it's a question of concrete. Concrete, it's more like a prime time to be dried, and wooden is that, if it gets wet, so what happens after that?"*
> [Architect 3]

Also discussed was how the engineered wood materials sometimes conflicted with existing building codes. For example, fulfilling the noise limitations requirements in Finland's building codes can be problematic due to the wood frames technical aspects:

> *"This noise kind of thing. It's harder to prove in wooden construction that it, fulfill this noise, criteria […] They have to make, VTT […] do this kind of…neutral, checking [4]or, how do you call it."*
>
> [Architect 3]

Fire safety was also discussed. While civil servants do not perceive an elevated risk of fire associated with WMC, many discussed the financial repercussions of the building code fire safety legislations forcing the compliance of a unique sprinkler systems:

> "*What we know so far is this sprinkler system should be there and this is of course, a little more cost*."
>
> [Mayor 4]

The remaining discussions surrounding WMC material limitations also tie back to negative impacts on project finances. For example, one civil servant mentions a design restriction in stairwells that result in the loss of marketable apartment floor space, while another describes the need for thicker walls becoming a financial burden:

> "*The economical side is, that wood is more cost, costs more, and therefore there are some law points which reduce the costs. Especially the staircase rooms are bigger in wooden houses and, it depends how you count it. But if you think about a building you have to sell the square meters and if you have more square meters somehow you have to sell them and then the square meter of the apartment would be higher. But if you don't count everything from the staircase room it's much lower.*"
>
> [Architect 5]

> "*But the main point is that, outskirt is the most expensive part of the house, and when the middle thing is thicker, it also means quite a lot more of this, expensive outskirt*."
>
> [Architect 3]

That WMC projects requiring larger staircase or thicker walls is only considered a limitation and hindrance because of the cost aspects associated with it. The same could be said of the fire sprinklers systems, even though some civil servant argues that the WMC apartments are safer than BAU in terms of fire, the cost is a hindrance. More than anything, the fundamental material challenges arising from the use of engineered wood products in

[4] "Neutral checking" refers to the impartiality of VTT's acoustic assessment

WMC ultimately tie back to question of finance. They are challenges with solutions, but securing the solutions is more costly or inconvenient than BAU methods.

Governments influence on a poor operating environment

Civil servants mentioned several national state regulations and local municipality policies as exacerbating the hindrances which prevent the implementation of WMC. This is due to severe regulations that punish the WMC industries attempting to enter the construction sector, and regulations that lack the impetus to strengthen the weak WMC industry.

The role of the state administration to support WMC industries was discussed by one civil servant who believed not enough developmental initiatives existed to assist WMC industries to breach the housing market. They compared the municipalities support for WMC industries, and criticized the lack of involvement on the side of the state:

> "*We have really good [construction material companies], like, which is doing, metal constructions. For example, the Heathrow terminal five, it was done for the Finnish [company]. Why not wood? Because we don't have the companies. And the state is not stressing, at all, to develop these companies and, something must be done […] The municipalities are also doing this business development. We have the business development system so in Finland that, municipalities and the Federation of Municipalities or the companies which are owned by the regional municipalities or cities, they are helping the business to grow. They are doing and giving these business development services. So, cities can really affect which companies are developed. So they really have a strong role on this […] but, the state is not doing the thing because there should be some kind of programme, or, something for developing this business.*
>
> [Development Director 10]

When this civil servant was asked about the role of Finnish municipalities to zone specifically for wood materials to encourage WMC businesses, the civil servant admitted that this practice was something which municipality should do more of, except that it was often met with lobbying (as discussed previously). As such, municipalities also share the burden of not being able to provide WMC industries with the key policies necessary to support developing companies:

> "*Maybe it's the same thing than in many other areas that, when there is strong companies which already exist, they are against and they are lobbying and, I don't know but, that's easy, I guess […] I think cities should*

> *use it more than they are doing at the moment. Because that's the whole key to help these businesses to grow.*"
>
> [Development Director 10]

For this same reason, another city planner also discussed their municipality's role to provide WMC industries with the necessary support to develop their methods and construction technologies. This support could be implemented through developmental program which provide continual support on an annual basis as opposed to the current sporadic support:

> "W*hat is, important, that at the moment we have too many pilot construction, wooden, new companies, new, in a way traditional, technologies, they are very similar to concrete, construction and the architecture is quite similar, and that's the reason why, what we need is, a programme, that those who are willing to develop some kind of modular systems and their technologies and their awareness how to build wooden structures, we, should have sites for them, annually, many sites. If there are single pilot projects in, one in five years or something like that that's not enough, if we are really trying to, promote the, wooden construction*."
>
> [Planning Director 11]

Another civil servant elucidated how the state's discussion on carbon neutrality and commitments to fulfil emissions goals through wood construction is currently hindered by the lack of formal regulations necessary to account for building emissions during building processes. According to this civil servant, the lack of mechanism that give actors the capacity to include materials in a climate calculation hinders them from considering the impact of the materials they use in construction. The process of accounting for a materials climate impact might be included in the current calculations used to obtain energy certificates during the building permit application process. Ultimately this is a responsibility of the Ministry of Environment to uphold:

> "*One thing that defines, the attitude is how is wood treated in, those climate calculations, when you get a permission for building. At the moment, what is important is the insulation, and that kind of energy efficiency. That is only thing that counts. The material doesn't count. And as we all know that, wood as a building material, they are not, on the calculations at all, but it is said that in the future they will be, and that make will make, wooden, construction more, attractive for any kind of, actors on the field of construction. […] So at the moment if you build, if you use any kind of,*

> *climate-unfriendly material, but if your insulation is enough, your building is climate-friendly. But in the future it should be so that, you need the insulation and energy efficiency, but also, the material is calculated.*"
>
> [Planning Director 11]

Lastly, the state administration was accused of not supporting or enabling the financial schemes necessary to carry out WMC projects. ARA, The Housing Finance and Development Centere of Finland run by the Ministry of Environment, was cited as having incredibly strict conditions for financing municipality development projects. Because of the many financial risks related to the weaknesses of the WMC industry (e.g. limited actors) having limited financial schemes in place to reduce this uncertainty only exacerbates risk on the municipalities end. This continues to ensure municipalities will not take on WMC projects:

> "*I think the money is the biggest thing. Because those buildings […] they are normally financed by ARA which is financed by, state of Finland…And they have a quite strong, or strict sums of money what one square meter can cost.*"
>
> [Architect 3]

While state regulations were criticized by some civil servants, it should be noted that almost all the interviewed civil servants admitted their municipalities lacked the formal strategies or policy adherence necessary to support WMC construction to some degree. Civil servants discussed how city strategies often did not regard material choice in housing solution strategies, but rather that one could make a case for the importance of wooden housing based on facets of sustainable development:

> "*But in city strategy we don't have, I mean wooden housing is not there, so that we say that we need it. […] You can say that it's in there when we want to make sustainable [city] or something else but we can't say that it's only wooden housing which solves this.*"
>
> [Architect 6]

> "*We have this kind of a asuntopoliittinen ohjelma. It's like a, living [strategy]…but more, it's also quality thing because, discussing what kind of areas should be developed but, not going deep into the materials.*"
>
> [Planning Director 7]

It was also discussed how municipalities favoring one type of material for construction was still a complicated topic of deliberation in Finland:

> "*You must know that there has been a lot of discussion in Finland that the municipalities and the, public sector should be neutral, to the materials."*
> [Planning Director 11]

A few civil servants discussed how their city did not have any official targets for the implementation of WMC projects:

> "*I'm sorry, I don't know. For that, do we have some, written letters or [...] I don't know. I think it's more like this that we have discussed about this that, there must be, several, projects, and also we have discussed about that some area, would be, wooden, house area.*"
> [Land Use Expert 9]

One planner discussed how the largest way to influence the municipality would be through the politicians. They felt that regardless of the countless number of memos, and even the discussion on wood construction in the cities strategy, there was no impetus for following through with these remarks:

> "*I think we need the politicians, to tell us to do this. It's more, it's the, most powerful way to get, things done […] I suppose we have, maybe dozens of, memos and, papers, where it's written that we, are going to plan this city to be very, sustainable. And I think they have even mentioned, this, building in wood in our strategy. So we are, I'm hopeful, but until now, there has not been, a clear demand to deliver what's written, to answer to that call.*"
> [Architect 1]

Amidst the criticism of laws and regulations, one civil servant believed that while laws and regulations certainly force development companies to change their behaviors, it is not the responsibility of the municipality to force builders to comply with material selection. It is up to the builders to decide which materials should ultimately be used, presumably meaning WMC actors should therefore improve their business-side operations:

> "*I think, building companies react much more to laws, and what they are forced to do, environmental things and materials and so on but, I don't believe that we are going to use, do this [force zoning] kind of plans in the future, that companies do their decisions by themself*."
> [Architect 8]

Lastly, mentioned in earlier section were the interference of building code regulations in project implementation. The limitation on the height of WMC buildings, the need for

expensive fire-sprinklers, and the inability to expose wood frame elements due to fire safety regulations were all mentioned in conversation. In January 2018, the regulation enforcing frame elements to be covered by fire proof boarding was lifted, but the height restriction and sprinkler system enforcements remain.

5.2. Impressions of exterior actors' beliefs towards WMC

The second research question that this study aimed to answer was what civil servants believe external actors value and perceive about the WMC. By using QCA to analyze the data, attitudes and opinions could be grouped and compared according to the actor whom held the belief. Quantitative frequencies for each mentioned actor group were compiled along with frequencies of each group's perceived personal attitudes towards WMC (see: Appendix C, Table 12-14). This data helps illustrate with which actors' civil servants have most rapport. A qualitative exploration was also conducted to gain an understanding of the how civil servants conceptualize and consider the world views of various actors. Presented below is the development of the coding framework, the quantitative analysis examining frequency of occurrences for each coding framework category, and the qualitative exploration of the largest actor groups.

5.2.1. The actor coding framework

The development of the actor coding framework was strictly data-driven. Actor subcategories were created if an interviewee mentioned the opinion of another stakeholder. All segments coded as a **1.0 Attitude Towards WMC** required a code from one of the **2.0 Actors** subcategories. In this way, all attitude phenomena can be distinguished as either a participant's opinion or as the opinion of another actor as interpreted by the civil servant. If it was not clear who held the imparted attitude opinion, the segment was categorized as belonging to **2.4 Other/Unknown.** Based on the data, a total of 4 major actor groups and 13 sub-categories were created (see: Table 4).

5.2.2. Primary actor inclusions and frequencies of their beliefs

In total, civil servants imparted 233 opinions on behalf of other actors. The cohort whose opinion was discussed in majority included the municipalities for which the civil servant themselves worked. Municipality opinions are a composite of the subcategories **2.2** to **2.8**

since these actors are merely different departments within a municipality. 104 of the 233 phenomena constituted opinions from different city departments (see: Appendix C, Table 12). The opinions of **2.3.1 Developers** were the second most mentioned group, consisting of 59 of the 233 phenomena. The third most mentioned opinions were those of the **2.2.1 Resident**, making up 43 of the 233 phenomena (see: Table 5).

Table 4 - Coding framework of actor groups whose attitudes towards WMC were shared during interviews.

Actors Groups	
2.1 Participant	2.8 The State
2.2 City (General)	2.9 Residents
2.3 City Planning Department	2.10 WMC End users
2.4 City Housing Management	2.11 Developers
2.5 City Housing Development	2.12 WMC Industries
2.6 City Leaders	2.13 Concrete Industries
2.7 Politicians (Elected)	2.14 Other/Unknown

Analyzing Table 5 reveals that there are various groups for which opinions are not discussed during interviews. For example, the opinions of public academic institutions are not mentioned. There are also very few cited opinions of WMC end user even though civil servants were directly asked about impressions from end users (see: Appendix A). WMC industry opinions and concrete industry opinions were both infrequently mentioned. A deeper analysis of the segmented phenomena is necessary to understand why such few opinions have been given on behalf of these group.

Table 5 – Overall frequency of mentioned phenomena that contribute to and hinder WMC projects on an actor by actor basis, as interpretted by the intervierwed civil servant.

	Contributes to WMC Projects	Hinders WMC Projects	Total
City (General)	36	24	60
City Planning Department	11	6	17
City Housing Management (Real Estate)	2	3	5
City Housing Procurement/Development	1	4	5
City Politicians	7	1	8
City Leaders	6	1	7
The State	4	0	4
Residents	23	20	43
WMC End users	4	1	5
Developers (General)	15	44	59
WMC Industry	3	3	6
Concrete Industry	0	2	2
Other/Unknown	6	6	12
Total	118	115	233

5.2.3. Unpacking the subjective norms of surrounding actors

Attitudes within municipality departments

The opinions of the interviewees were treated separately from the opinions of their employee municipality. This choice was made because individual do not always hold ideas in conjunction with their workplace. When civil servants shared an opinion that was affirmed as being mutual between themselves and their municipality (e.g. "we like WMC") then the opinion was coded as belonging to the city. A choice was also made to parse city opinions based on departments when possible to see if departments held conflicting views. If no specific department or entity was given when sharing the cities point of view, it was labeled as **2.1.2 City (General)**.

Because of the small number of interviews conducted, it was ultimately deemed unsubstantial to give a comparison of attitudes between the 6 municipalities on a case-by-case basis. Instead, the 104 phenomena are approached as a single cohort.

Civil servants were asked about the city planning strategies in their cities along with the current day perspective on future strategies for WMC (see: Appendix A). Cities held various attitudes towards WMC that fostered desire to engage in WMC, and some civil servants shared their municipality's interest in implementing WMC projects (see: Appendix C, Table 12).

Opinions regarding climate and the environment, supporting local and national economies, creating desirable cities to live in, marketing the city, and the erecting high-quality buildings were all cited as general reasons for cities to engage in WMC. These opinions aligned with the civil servants' own discussed perceptions on the contributing aspects of WMC (see: Section 5.1.3). In other words, none of the contributing phenomena which civil servants relayed on behalf of their city were unique compared to the opinions presented by civil servants themselves. The cities opinions are discussed in greater detail below.

The role of material selection was important to cities who had strategies to uphold issues of environmental concern or CO_2 reduction. It was also mentioned that various city leaders had recently made a statement to use WMC to fulfil their climate agenda:

> "C*ouple of weeks ago, the mayors of the biggest cities made a statement that they, will promote wooden structures more in the future, as a part of their climate programme*."
>
> [Planning Director 11]

> "*Yeah, and [our city] is so-called Hinku kunta, which means, the carbon dioxide neutral city. So that means, that, if you compare about this thing, then the wooden buildings would be a good choice for us also.*"
>
> [Development Director 10]

Cities also value the promotion of WMC projects when it will benefit the broader working economy of Finland, particularly on the bioeconomy level. Supporting the forest industry on a national scale in the development of 4th generation forest products was mentioned:

> "*I think it's it comes from the nature of Finland, the lot of woods, forests and we have [more] and we are using at the moment, wood as, we don't cultivate or refine we don't, have high-quality production wood, we are just burning it and making paper and that's not enough. So that's of course the main reason. […] And we are willing to, develop part of the development that we, get the modular systems we can sell also abroad. That's, export is one important thing also.*"
>
> [Planning Director 11]

Likewise, cities see the benefit of economically supporting the local WMC industries and ecosystem actors through the promotion of WMC projects:

> "*So it's also promoting business, this WMC because we have those factories and, […] we have a lot of those, people who are working with construction site they are, timber carpenters and so on, so, of course, it will create more, new jobs also.*"
>
> [Development Director 2]

Yet, supporting the WMC industry is not a one-sided relationship. One municipality promotes project continuation within the WMC industry among building developers to enable the transfer of WMC building construction technologies and knowledge. The idea is that this will ease project implementation in the future, and that the municipalities stand to gain from this because WMC projects will be less developmentally risky:

> "*We have also discussed…that, if we have some wooden projects they must be kind of, not mass production but, continuing production and there must*

> *be, some eight house or ten house or so on, that they really, can keep on, doing it and […] learning something and so on.*"
>
> [Land Sales Expert 9]

In terms of lifestyle, municipalities consider the higher quality standards of living to be gained from WMC as a positive aspect of WMC:

> "*Everyone sees it as a, higher-standard living…we are talking about quality, it's quality,[and] wooden [living] and they are combined together in this way."*
>
> [Development Director 2]

One civil servant also shared that the cultural and historic aspects of their city fostered the municipality's desire to consider WMC. Fulfilling this desire relies on WMC can satisfying traditional expectations with aesthetically modern wooden designs:

> "*We were wooden city…it's something like 1930s when wooden construction in the city centre ended and the stone and concrete construction …replaced it. But we have to, continue the tradition…but in a modern way of course."*
>
> [Planning Director 11]

Branding and marketing has been considered a key aspect of WMC from several cities' point of view. Admissions that WMC is used to brand the cities agenda to support local industries was given as one example. But more generally, using WMC projects to proliferate the cities agenda to other exterior actors was reported:

> "*Because we have this paper and pulp industry here. OK, the wood you have to show also the brand, the image that we are a paper or wood city, like that perspective also. So I think, if that is not the first priority, it's really high in the priority list anyhow*."
>
> [Development Director 10]

> "*I think that, it's, we want our city to profilate (sic), to have a profile, of a city which is, which are doing these kind of buildings*."
>
> [Development Director 2]

While some cities see the ability to market and brand the WMC projects as a positive conduit of spreading information, in one case the original goal of implementing a WMC project to satisfy an urban design trend ultimately backfired due to project difficulties:

> "*Yes. I think that when this [WMC Project] area was designed in, it was five years ago. So then it […] was like a trend that you build by wood and I think that after five years now it has changed a little, that it's not so trendy. It's perhaps more important that, everything works and the city works with all the costs and, things like that.*"
>
> [Architect 2]

Conversations about the attitudes which hinder cities from implementing WMC parallel the overall hindrances imparted by the civil servants' personal opinions. This included: a weak WMC industry, the high cost of project implementation, material limitations, risk because of poor information distribution, and limited government interference. Two major variation in attitudes exist. First, cities were sometimes cited as still having concerns for fire safety even though no civil servant shared this opinion:

> *"But some of the, city officers…they are worrying that it would not be safe, for example, for the fire regulations."*
>
> [Architect 1]

Second, some cities did not regard the opportunity to use WMC for marketing in branding:

> *"I know many cities who use wood as a branding the city but, I think it's not happening here at the moment anyway."*
>
> [Architect 8]

Additionally, unique to this cohort was the emergence of what causes certain municipality departments to be disinclined to work with WMC projects. For example, there is limited interest from city real estate departments because they need to satisfy housing demands, but have experiences of WMC projects coming to a standstill in the past:

> *"But, within the city organization, it has been the real estate, that has, not, been very fond of the, new ways of building. […] They think it [WMC], could be risk, it could delay the process of, getting new projects, built. And at first it was the case, because it was, entirely new way of building"*
>
> [Architect 1]

City owned developers similarly see a great deal of risk involved with WMC projects:

> "*They haven't I guess made, any of those [WMC] houses to be sold. Because they haven't been sure if they are good or bad…they are afraid of risks and, therefore they do all those, wooden construction then to be […]*

> *owned by city. Because, then they are owned by city and nobody can complain.*"
>
> [Architect 3]

One real estate department points to strict municipality guidelines keeping the emphasis of construction on either subsidized housing or volumes of zoning, not giving room to considerations of materials:

> "*It's not a strategic, question, so much that, I think we are more interested, and we are, also forced to, focus on subsidized housing and some, volumes of, zoning. I think they are our priorities."*
>
> [Land Sales Expert 9]

City planning departments and real estate departments disinterest in wood material is also based on cost restrictions, although it is unclear from where the directive of these cost restrictions arise. What is described is that cost is measured by the bidding and sales competitions of project land to external developers:

> "*But I think at the moment it has been discussed that is, the rest of this area is it going to be wooden or something else…We can't favour if it costs more than normal, some else material […] It's the cost at the moment, do the builders pay enough about this land because it's, decided it's wood*."
>
> [Architect 6]

> "*We asked for offers, for that lot, and the offers were, 600 euros, lower per square meter than the, other nearby areas. But we don't know, exactly how much it was about wood construction, influence or was it, really, just the detail planning, was it a, planning mistake or, some wooden catastrophe."*
>
> [Land Sales Expert 9]

Lastly, there has also been some criticism of politicians. Some civil-servants have suggested that their municipality politicians are uninterested in matters of material selection, and this may be impacting the municipality's capacity to work with wood.

> "*But the role of wood, doesn't play a role for people and for the politicians but for us [city planning] it means very much*"
>
> [Architect 5]

Municipality citizen opinions

The opinions of the end users and residents are compiled together in this section to create an understanding of how civil servants interpret the attitudes of municipality citizens. End

user desires were infrequently discussed. Resident desires were often discussed and make up one of the largest pools of normative attitude phenomena collected. Overall, the few end user opinions shared recount positive associations of the living environment from inhabiting a WMC building. Views on residents' opinions are mixed—and sometimes conflicting—being split evenly between hindering and contributing attitudes.

All civil servants were directly asked to recount attitudes or opinions which they believed end users might hold towards WMC according to the semi-structured interview questionnaire (see: Appendix A). Regardless, end user experiences were not shared. As described in the Section 0, civil servants perceive difficulties acquiring end user thoughts on WMC. As a result, only 4 opinions were shared on behalf of the end user (see: Appendix C, Table 13). These consisted of different aspects of the living environment being overall positive qualities of WMC. End users appreciate the aesthetic use of wood in buildings, and aspects related to the auditory atmosphere associated with living in WMC buildings:

> "*They [the end user] like when they see wood and they feel it like a home-ish material. The other thing was […] they interviewed many people there, inhabitants, in those wooden buildings. People were...especially…the sound, atmosphere, it was like surprise for everybody that…because nobody had even thought that it could be different but people said that it feels like…good, good instrument.*"
>
> [Architect 3]

> "*Those very few who live in those kinds of buildings, they like them and they, seem to, enjoy the, feeling of the, place, the, touch or even smell of the material. […] People, seemingly, people think that it's, nice and cozy.*"
>
> [Architect 1]

Civil servants presented far more opinions on behalf of the residents of their municipalities than of WMC end user. Some accounts of resident opinions towards WMC conflict. Because there are many Finnish citizens it is logical that attitudes might vary. For example, some residents are said to show interest in WMC construction and others not. Likewise, some residents believe that WMC is safe while others might not. More importantly, it seems that citizens' prior exposure to WMC is a large antecedent to the

citizen's formation of positive attitudes towards WMC. Limited WMC knowledge may results in negative attitudes.

Overall, the positive attitudes which civil servants shared on behalf of residents included experiences based on lifestyle aspects, especially the built environment aspect (see: section 6.1.3, WMC Lifestyle). The wood material itself is positively regarded and is pleasant to look at, and some residents believe that living in a WMC home might have positive health benefits:

> "*It's more architectural, things, this material, how does it look and how does it feel […] Quite often they want to live there because of the feeling which the wood gives to them And it's like more feeling and the image, which attract them.*"
>
> [Architect 8]

> "*So it's, there are, those are important for the residents, and of course, it has some, positive meaning for cityscape, like the looks, these wooden building…I think, in general city, thinks or sees that, people think it's, a positive thing to have these, wooden buildings. It's, nice environment.*"
>
> [Architect 1]

> "*Some people believe that wood have effects to your health*."
>
> [Architect 8]

One city planner also felt that citizens from outside their municipality support the erection of WMC projects on the premise that they understand it affects their personal local forest economy, presumably by creating demand for their forests' raw materials. This is in line with civil servants' personal beliefs regarding the benefits of WMC economy:

> "*And of course, if they [newspaper] say that [our municipality] supports and raises the wood construction, they're [local forest owners] quite happy because they live on their forests and so on*."
>
> [Planning Director 7]

Civil servants shared that residential neighbors of existing WMC buildings have supported the continued construction of WMC projects in their municipality. In two cases civil servants felt that neighbors look forward to additional WMC projects principally based on how the buildings look. Furthermore, one civil servant also commented that residents are looking forward to inhabiting the upcoming WMC buildings in the municipality:

> "*I think more and more, we meet those kind of, yes-in-my-backyard people, who are willing to see the change. I think it's changing, little by little.*"
> [Architect 1]

> "*This was very good [WMC project] and people like it very much. Now we can make another one maybe a third one what here is also coming.*"
> [Mayor 4]

On the other hand, some civil servants expressed that material choice in the frame of a building does not frequently make a difference to their residents when they are considering the purchase an apartment. Citizens are indifferent to WMC:

> "*I think they don't care. It's quite the same for people. And I could think, and, I'm not pessimistic, I'm just a realist but, people doesn't care.*"
> [Development Director 10]

> "*Today I think that, only a minority want WMC building. And, majority, don't care about it, so much. They just want to have their own apartment and buy it, or have a rented apartment.*"
> [Development Director 2]

Civil servants also mention how most residents are not willing to pay a premium for the frame of their building to be made of wood. Instead residents are interested in other salient aspects. When disposed to paying a premium, residents consider apartment location and quality as more important features:

> "*It's just the same because they don't, appreciate so much this wooden construction that they are eager to pay more for it*."
> [Mayor 4]

> "*They [residents] will make any difference about this, concrete or wood. I think it's more about, that place and situation and, price and so on.*"
> [Land Sales Expert 9]

Even the few civil servants who discussed that there might be some residents who would be interested in paying a premium for WMC homes believe that this group of citizens is quite small. Likely, it would be consumers who are aware of ecological aspects of WMC that would be driven to purchase WMC on a premium basis—and that still might not be the most important feature of their apartment worth paying a premium for:

> "*I think that there are always you can find that kind of, people which are aware of the, for example climate impact of the wooden construction. And they have that kind of awareness and they are, maybe willing to pay some extra, not very much but, some extra. But, where the building is situated it has more meaning or value*."
>
> [Planning Director 11]

Another facet associated with the cost of WMC links back to how residents may feel financial uncertainties towards purchasing a WMC home. The newness of the construction method is believed to be off-putting because residents are uncertain what this new lifestyle will entail. Many residents have not been inside a WMC building and are therefore skeptical of taking the leap to live there. This feeling is compounded by the pressure associated with making such an important lifetime purchase, where residents usually want to minimize their purchase risk:

> "*We are talking about these multi-story wooden buildings. So it's something quite new, for the residents, and not very many have, ever lived or even visited, in, such buildings. So it's, new for them*."
>
> [Architect 1]

> *"When, a family buys an apartment, it's usually their biggest investment of the lifetime. So, if there's some small, prejudice on wooden construction, it might, have a big effect on the markets. You have to beat that prejudice or the feeling of the people. [...] They are not willing to make any risk when they make the biggest investment of their lifetime."*
>
> [Planning Director 11]

The lack of WMC consumer information has served to exacerbate the issues of uncertainty in residents. For example, the topic of fire risk is seen to be matter which residents still question about WMC, even though the civil servant themselves do not believe these to be issues of substantial consideration. One city planner discussed how real estate agents have done a poor job of dispelling this uncertainty by not providing consumers with enough information:

> "*Of course. There are many of them because, as a normal people you think that it's wood and it's easy to burn it. But we know that it's not so but there are maybe someone who thinks so*."
>
> [Development Director 2]

> "*But quite many people who are buying apartments don't know that. They could sell those apartments as well more, fire-safe, in some sense."*
>
> [Architect 8]

And as discussed earlier, the skepticism about health safety due to moisture is a large issue of debate in all construction matters in Finland. Due to previous negative publicity on a WMC project being erected in Finland as having had some issues with moisture, one civil servant believes moisture is already creating prejudice for WMC in the eyes of residents:

> "*The words I haven't mentioned is moisture. That makes the, prejudice for people and the, fears, people, so, high that it's the one of the important, things, maybe preventing the, popularity of wooden constructions. People are afraid of the problems with the moisture. Because of course, they are very, common also in other materials as well.*"
>
> [Planning Director 11]

As a final point, it seems that the consumer information which circulates concerning WMC within the residential actor group is still very limited. This is not surprising due to the small number of WMC projects throughout Finland, and given that the civil servants themselves often lack access to WMC information. For this reason, the aspect of prejudices is made even more relevant. In one interview, a one civil servant discussed the positive feedback garnered by residents in their municipality after a housing fair exhibition showcased a WMC building. Here the civil servant overheard residents discuss the positive lifestyle features of WMC, and as a result the civil servant believes the citizens of the municipality to now be interested in WMC. It seems that providing information to consumers can help change their attitudes:

> "*And of course, when you are talking about, how is it to live inside a WMC building, and when we have this housing fair, then many people there were discussions about it that, is it, is the climate inside a wooden building is it better, and there were some talking about that it's better, and, then sounds and noise inside building, is it different or not, those kind of things are very important because if normal people hear, get notice that, when you are living in a WMC building, the climate is better or the noises are less, there are less noise, of course then you, start to think that, I'd like to live in a building like that."*
>
> [Development Director 2]

Overall, WMC end users seem happy with the aesthetic life inside a WMC home, but not much other information can be provided on behalf of this cohort. Likewise, residential

neighbors also appreciate the aesthetics of WMC buildings. On the other hand, most residents lack the information about salient lifestyle aspects obtainable from living in a WMC homes. Residents are therefore disinterested in paying a premium for these buildings and are believed to care more about aspects like location and cost than environmental impacts. Lastly, the newness of the building technologies and lack of consumer information may foster sentiments of distrust and risk for what is one of the citizen's most important life purchases. Some prejudices to fire and moisture issues are believed to exist, and that these prejudices will only exacerbate without consumer information. In one municipality, residents that have been exposed to WMC consumer information have generally liked WMC buildings and would consider living in them.

Private developers

The developer subcategory is comprised of actors which have been referred to by civil servants as "developer" or "builder". Builders were included in this subcategory because in Finnish the term for a developer is sometimes used interchangeably with the term builder. Even though some builders exist as separate entities available for subcontracting by developers, their identities become interchangeable because most development firms in Finland have company owned builders. There are few large-scale developers in Finland who operate strictly as "developers" in the true sense of the word. Therefore, it was too difficult to ascertain whether the civil servant was referring to a builder in the true sense of the word, or merely to the development company. Where civil servants used the term subcontractor, it was assumed the civil servant was referring to a "builder" in the true sense of the word, and they were not included in this cohort.

The opinions of developers make up the second largest pool of normative attitude phenomena collected. Overall, civil servants described far more hindering phenomena than contributing phenomena from the point of view of the developers. The positive opinions that were imparted on behalf of the developer mainly discussed circumstances where positive WMC project implementation experiences resulted in a desire to continue project development. Negative opinions largely revolved facets which may affect the developer's bottom line. A summary can be found at the end of the chapter in Table 6.

Civil servants believe that developers are beginning to realize that taking on WMC projects will provide them with new business opportunities. As municipality and national level construction agendas shift to support sustainable development, there is perceived recognition on the developer-side of the importance to undertake WMC projects:

> "*But, there are some, companies who, seem to think it's good business for them, building, with wood, with timber*."
>
> [Architect 1]

> "*They [developers] seem to be interested. They know that maybe in the future we will build quite a lot of more in wood."*
>
> [Planning Director 7]

Civil servants discussed that developers in their municipality are motivated to continue building WMC projects having had successful pilot projects:

> "*And it has been interesting, the construction company [--], which is one of the biggest, and they have been very happy with the project and they are interested to, build more, multistory buildings."*
>
> [City Planning Director 11]

> "*And [developer] in the beginning, they didn't like wood-constructed buildings. But now, when they have built there, almost two houses, now they are interested to build more.*"
>
> [Architect 8]

While not a lot of specific details were shared regarding what aspects of projects developers seem most pleased with, one civil servant did share a developer's opinion regarding how motivation in part stemmed from the capacity to sell these new WMC projects so easily:

> "*They [developer] were even I think themselves, a bit amazed, how easy it was for them to sell those apartments. And that's why they are now building other one. It's not near, it's not in centre it's about three kilometres from city centres. But anyway, they selled it.*"
>
> [Development Director 2]

Some speculation could also be made about another motivation for WMC project implementation. Developers were said to be noticing some qualities in building with WMC which are better than the BAU concrete methods. As one civil servant said,

developers have noticed that it is quicker to erect a building made up of wood than of concrete:

> "*Many of them have now, I think, noticed that it's, like, to use wood, it makes it faster to build the buildings. Maybe it's like…that wood is in that sense better than concrete at the moment.*"
>
> [Architect 8]

Developers are also motivated by the financial investors who fund their projects. In one interview, a civil servant discussed how the developer in their municipality had been prompted by a financial investor to take on a WMC project because of the positive marketing and branding image which the projects gave to the investor group:

> "*So, I think the investor has chosen this area because of the wood. They have seen it as a part of positive image.*"
>
> [Architect 8]

A general feeling is that a handful of developers are beginning to change methods and take on projects outside of the standard BAU method of construction. Civil servants noted this change based on conversations with developers where the developer approached the municipality already with the interest to engage in WMC construction as opposed to being forced by municipality zoning regulations or design competitions:

> "*But it's yes it's getting, there are, more and more cases that there are constructions they [developers] build, in wood even though we have not, regulated in our plan."*
>
> [Architect 1]

> "*I know there are a few companies which are not working there and they have been asking is there any areas where they could build wood-constructed multi-level houses.*"
>
> [Architect 8]

> "*But, about those five block houses, there are at least two, are planned to be these wooden multi-story constructions. […] They just want, the builders want to build these."*
>
> [Development Director 10]

Despite the small shifts in developer attitudes, the consensus is that WMC is still seen as largely problematic in the eyes of most of developers. There are many attitudes which result in developers being largely uninterested in WMC, but the principal factor discussed

is cost. This is because developers usually take on the entire financial risk of all aspects associated with a projects lifecycle. As such, many civil servants expressed developers disinterest in WMC construction where WMC might create any financial risk or uncertainty. Developers have stated that cost is relevant given that they operate on such strict profit margins. Yet, it is interesting to note that civil servants' personal opinions on the sincerity of this statement is conflicting, because one city planner accepts the statement that profit margins hinder developers, and another civil servant does not:

> "*But the building companies are quite conservative […] And I think, they don't want to try. And I know why they're conservative. They're conservative because they rely on really small profits, and they know how to do, with the concrete they know how to calculate but they're very very afraid they're making a mistake building wood construction. Otherwise I don't think they have anything against building wood. […] They're telling me that they have this problem of the profits*.
>
> [Planning Director 7]

> "*Yeah they are, a little bit worried that it will, be too expensive for them. And that's very interesting when they say it's too expensive, what does that mean, because, they profit a lot. They really do.*"
>
> [Architect 1]

Because profits incur a bottom line mentality in developers, the attitudes towards those aspects which create financial uncertainty and risk are several. Developers are concerned with how they will sell the WMC buildings, since they are a new residential market item. Developers perceive that residents may not be interested in WMC due to prejudices like fire safety:

> "*For the builders they have to be, take very care that if it's, not so cheap to build, how can we sell this and, how can we gain money from this."*
>
> [Development Director 2]

> "*In the beginning, many building companies, thought that people, maybe at the moment as well, they were afraid that people don't like wood because it's going to burn, and that it's more dangerous material than concrete.*"
>
> [Architect 8]

Some developers also expressed concerns with how certain technical aspects of projects would manifest due to a lack of experience building with WMC technologies. Solutions would need to be found for some building code regulations, like in the case of acoustics.

Likewise, a lack of previous experience planning WMC projects meant more dedicated man-hours in the design and planning phases, which becomes more expensive than BAU. Lastly, projects require plastic tents over the building site to keep materials safe—this is also needed in BAU construction, but oftentimes is neglected. This neglect perhaps comes from project experience and knowhow, and in WMC this risk cannot yet be taken:

> "*Or is it, is it good and, what about acoustics and this kind of means*."
> [Architect 6]

> "*What is expensive is, that they have to, put more effort to planning. They have to, make models beforehand to check every, part of the construction. It is new for them so they have to do it more carefully*."
> [Architect 1]

> "*And when they build, these buildings on the construction site they have this huge tent, over the building site, so it, will cost more, than normal.*"
> [Architect 1]

Private developers must also guarantee their building for a set period of 2, 5, and 10 years. Therefore, uncertainties in how a project might age over time results in a financial unknown which cannot be calculated as easily into financial plans as with the BAU financial schemes which are easily calculated due to their normative standing:

> "*Building companies were kind of afraid to use wood because it was new material and, when they have built the building, you have like some, is it two years and ten years like guarantee that building is going to be OK. And because it was new material, they were afraid that it's going to cost more afterwards, and they were really unsure to use it.*"
> [Architect 8]

Developers are also wary of the limited number of actors and subcontractors able to put WMC projects together; a lack of actors means lower competition and higher construction prices. This is aggravated by the differences in a WMC project value chain versus a concrete construction value chain. In WMC, the value chain of the elements needed to assemble the building come from various actors. In concrete construction, there is usually only one actor providing the elements. This results in WMC developers depending on few and multiple actors for elements, increasing a projects risk. The developers cannot be as self-sufficient or certain as they would be with a concrete project:

> "*That probably rises the prices as well because there's not so much competition between the companies*."
>
> [Planning Director 7]

> "*But what we asked those, who made offers, we asked those and they told us that it's not so easy to put this, house, under construction because, there's only one or two firms, in Finland, who really, has done it, many times and they have the, experience of it.*"
>
> [Land Sales Expert 9]

> "[*Developers] can't handle this whole value chain, and maybe it's much easier for them to handle it as a whole. But in wooden construction because somebody is doing this CLT or whatsoever, so you can pick up this part from here and this part from here and so on so, it's much more maybe, you need more time maybe for that and, take maybe more risks by yourself, if you are doing these wooden blockhouses*."
>
> [Mayor 4]

On top of the few WMC construction actors, there are also many technologies and methods used to construct WMC projects. This information is dispersed throughout different actors, usually various subcontractor and consultants. This hinders finding the experienced individuals needed throughout all points of a projects construction lifecycle. The dispersal of information on the technologies used to assemble WMC has been mentioned by developers as being exacerbated by the lack of WMC projects. Too few projects mean that subcontractor working groups have had to split apart, taking with them the group experience needed to implement a WMC project:

> "*And in building, in construction industry, there is also always there is a, working group which, consists those builders and planners and so on, and they try to, make this, group…they try to, continue with this same group, in the other projects. And if there's much of projects, it will stay that people will stay in that, group. But if there's not so much projects, one will go and other will go there, out of that and, so on […] And I was told that, there was a, steady group and they do good and they learn, many things, during those projects, but then there was no, demand, for those projects so…"*
>
> [Land Sales Expert 9]

Financial analyses become so critical to developers, that there have been cases where upon the realization that the financial risks are too high, developers have withdrawn from project implementation. This includes circumstances in which developers have already

participated in, and won, architectural competitions that give them the rights to build projects:

> "*Some of the big companies which were there, they just abandoned their reservations and, flew away […] The economic calculations because, they, maybe they made too idealistic proposals for the, architectural competition and, when they, really started to calculate and develop the, final plans they noticed that, it's not, at the point when it was, couple of years ago."*
>
> [Planning Director 11]

In the end, the reason for why the bottom line has become so paramount to developers in Finland is simple: Private developers take on the entirety of the financial risks associated with all stages of a projects development. This includes investor fundraising, project design, project construction, apartment sales, and the liability guarantee period post-construction. At all these stages developers must ensure having financial means to carry out their task. The exception to this rule is in the case of rental flats owned by the municipality, in which case the developer's job is reduced to only carrying out the building construction and repairs. Financially speaking, the burden of fundraising falls on the municipality, ergo the financial risk is that of the municipalities:

> "*In Finland when you have these wood-constructed buildings and you have competition, so the company has to build the building by itself. Invest the money and build the building and sell the flats. And it's a huge risk for them. Quite often, in Sweden they started in that sense that cities build new housing, to rent the apartments for the citizens. So the city was paying the building, and, the city was making the investment, and the building company only was building the building, doing the construction work. So they didn't have economical risk in this new material. The investors took the risk. It was quite often the state or the city.*"
>
> [Architect 8]

> "*And it is, very hard to those building companies, if they have to, own those places, if they have to rent those places. It's not, it's the biggest problem in, this day, in the, construction and housing. If you sell that product it's a big problem. In subsidized housing there's not so big problem because there's, government money and, it's not so big problem*."
>
> [Land Sales Expert 9]

In the cases where the city does not take on the financial cost of a project, the developer's perceived sense of risk can be mitigated by the municipality coaxing the developers with

other perks. For example, providing a building site in a well-situated area is one method to increase developer's interest in a WMC project–presumably because this guarantees the sale of apartments for a price which will satisfy the developer's financial assessment. On the other hand, developers have not all accepted the idea of using branding and marketing of the beneficial aspects of WMC as a safe or valuable measure to mitigate the questions of risk. Developers operate on very hard and assured risk management criteria:

> "*As a city we, provide, sites for building, and if we are willing to, promote something new, which has some special costs, we must give good sites for the builders, because, if we give them second-level sites somewhere which are not interesting, far away from the services and things like that, they are not interesting to build, anything new. But if we are giving for example almost in the city centre, near the river and things like that, it should be more interesting.*"
>
> [Planning Director 11]

> "*It's not like part of their marketing, the material, at the moment […] We have tried to sell this as well for the building companies that this is a really good reference for them because it's really city area, and if they're going to build there something interesting, new, like new housing and architecture and things like that, its impact and effect and have really positive effect to the image of the company, in the future as well but, it's not so easy to sell that idea further.*"
>
> [Architect 8]

Overall, developers are perceived to be largely discontent with taking on WMC projects due to the various risks involved. Only a small handful of developers see the future potential of building with wood. There are some technical aspects which incur high costs of building to developers. The operating environment is perceived to involve a high amount of development risk. This is due to the multiple value chain actors needed to implement construction in an environment that has too few actors, and scattered information on building technologies. Coupled with the market responsibilities of selling a new product which they cannot be certain will satisfy consumer needs or technical guarantees, financial risk is furthermore exacerbated. In the few circumstances where developers have undertaken WMC projects and managed to dispel these risks through successful implementation and sales, the developer has expressed interest in continuing with further WMC project construction. Some strong motivators for undertaking projects

include an investor's precursory interest to fund the project, or municipalities providing suitable building sites that dispel developer's perceived risk.

Table 6 - Summary of developer attitudes as interpreted by civil servants.

Developers Attitudes		
Project Problem:		**Results in:**
Technical aspects	• Acoustics management	Development risk
	• Project construction tents	High cost
	• Difficulty modeling	High cost
Operating Environment	• Few WMC industry actors	High cost
	• Multiple actor value chain	Development risk
	• Few firms to carry out project	Development risk
	• Many WMC building technologies	Development risk
	• Lack of WMC knowledge	Development risk
Market Responsibility	• Selling new product	Financial risk
	• Liability period	Financial risk
Mitigating Risk	• Valuable building site	Effective measure
		Ineffective measure
	• Means of self-branding	Effective measure
	• Investor interest in branding	

Private industry, the state, and other actors

Asides from the 3 principal actor group (i.e. municipalities, citizens, developers) opinion given on behalf of other entities was extremely limited and dispersed, and usually tallied less than 5 examples. Some private industries were mentioned, like the construction material industries. The bottom line was that the typical BAU construction industry was not in favor of WMC because it was in direct competition to their work. These industries were therefore attempting to lobby against regulations or policies which would dictate material selection in zoning plans:

> "*The building industry, the main, the majority of the building industry, concrete building, steel building, glass building and, whatever, they said that, it should be, they lobbied that everywhere you should be neutral*."
> [Development Director 11]

Where WMC ecosystem actors were concerned, civil servants perceived that these actors were hard at work to develop their products and WMC projects but faced several challenges still. For example, WMC developers face many hardships in financing and manifesting projects. Of course, it is sensible that the industry is in support of projects and looking forward to WMC projects being supported by municipalities:

> "*Some have said that, excellent idea, this [WMC] is good. It's mainly people who work with the wood*."
>
> [Planning Director 7]
>
> "*I have heard, they have been really active everywhere, and due to that, they are in some kind of problem to get the financing for buildings and also in [our city] they haven't started it yet, because they have so many places ongoing at the same moment and, then there's the financial situation that they don't get any financing any more. So they have to end somewhere to be able to start new ones.*"
>
> [Development Director 10]

The state's role and opinion regarding WMC was also discussed briefly. Primarily mentioned is the state's support for WMC due to the sustainability issues which WMC may help foster and propagate:

> "*But I think this CO_2 is one of the biggest things, that even environment minister has woken up and it's something*."
>
> [Architect 3]

Other actors mentioned in passing include: the NGO student housing developer HOAS, the state financial entity SITRA, the Green Party, and university groups. All these entities were cited as being involved or interested in WMC construction, but nothing more can be said as no other discussion pertinent to their opinions exists:

> "*And I think Sitra also have, has some, project about this wooden […]*."
>
> [Land Sales Expert 9]
>
> "*But one point of view is also here that we, we also, in these, which is now being built this HOAS and Asuntosäätiö...*"
>
> [Architect 6]
>
> "*I've been to several seminars and so on with the local schools, are quite interested in promoting the wood construction.*"
>
> [Planning Director 7]
>
> "*Of course we do have, the Green Party in politic. They are pro this kind of, development.*"
>
> [Architect 1]

Lastly, the role of research institutes in conjunction with other actors was mentioned only in passing. From the point of view of TEKES or other research institutions, supporting WMC is valuable, as it closes the knowledge gap between actors. From the point of view

of other actors (i.e. builders and cities), this entails a lot of work which can be burdensome and complex given the large amount of work already required in manifesting these projects:

> "*Quite often, universities and, for example Tekes and, actors like that, they want to use this kind of areas to do the research, which is for those who are working there quite hard, if they have to give the information all the time, away, and report and do things like that, and I think, quite many building companies or as well people who are working in the city, they don't like to have those because it takes so much time. So that's in a way a problem because, it would be good to share the information, but at the time, because, many people have so much work already so they don't have time for that.*"
>
> [Architect 8]

Overall, civil-servants mostly mentioned impressions on behalf of residents, developers, and their own municipalities. What went unanswered was why these were the groups most frequently mentioned. Also uncertain was whether respective to one another these groups held influence over the municipality's decision to implement WMC buildings. Given that the research question was focused on the attitudes perceived by exterior actors, it is not out of line that these questions cannot be currently answered.

6. Conclusion and Discussion

The results of the civil servant interviews have revealed a complex number of attitudes towards WMC. There is support for WMC due to the benefits incurred by the positive qualities of the engineered wood products, which permit flexible construction technologies that directly enhance citizen lifestyles while supporting local and national economies (see: Figure 3). On the other hand, civil servants see cost and riskiness as barriers in undertaking WMC projects because the operating environment is full of topical misinformation, few WMC industry actors and limited government policy measures to support project implementation (see: Figure 4). WMC projects are not seen as bad products, but instead there are market and industry aspects that hinder WMC implementation.

On the stakeholder side, municipality opinions and attitudes were largely in line with those of civil servants. No new opinions regarding contributing aspects were mentioned. On the hindrance side, it was discussed that some city officers did have concern regarding fire safety in WMC, and some cities believed WMC could not be used for branding and marketing. Interestingly, some municipality owned real estate departments and developers were mentioned to not have interest in WMC. Politicians were important for instilling change, but also were sometimes mentioned to lacking interest in WMC.

Citizen opinions were split between hindrances and contributing aspects. Positive aspects included living environment and built environment aesthetics, and the mention of potentially positive health effects, although this was not elaborated upon any further. Civils servants largely perceived that citizens are uninterested in material choices and unwilling to pay a premium for WMC, but exposure to WMC projects shifts and increases resident interest.

Developer opinions were largely against WMC due the perceived hindrances in project implementation at various stages of a projects lifecycle. Developers are focused on the bottom-line, so the multiple stages of risk deter this group from choosing WMC. Developers also require collateral to take on WMC projects. On the other hand, there is some interest in WMC as developers acknowledge the popularization of wood

construction in Finland. Successful projects have also helped dispel some developer risks and helped reaffirm that WMC assembly speed if hastier than concrete projects.

This study's findings on stakeholder beliefs are in line with Bysheim & Nyrud's (2009) findings that architects see contactors (i.e. developers) and real estate agents as being largely negative towards the use of wood. In this study, civil servants see the same groups as skeptical and uninterested in WMC. The overall attitudes and opinions in this study were additionally compared to the results described by Gosselin et al.'s (2017) meta-analysis of 53 academic journals, which outline barriers and motivators of residential and non-residential WMC. This study is chosen as a point of reference because it succinctly summarizes the limited research that currently exist on WMC implementation.

Gosselin et al. synthesized the most frequently mentioned motivators and determined 5 major topics (i.e. sustainability, technical aspects of wood, cost reduction, building erection speed, aesthetics) which consisted of 31 underlying topics. In this study, civil servants' opinions corroborated all the 5 major motivators, and 18 of the 31 underlying topics mentioned by Gosselin et al. (see: Table 7).

Gosselin et al.'s (2017) synthesis of barriers included 6 major topics (i.e. building codes, lack of expertise, cost, technical aspects and material durability, culture of the industry, and material availability) which consisted of 32 underlying topics. In this study, civil servants' opinions corroborated 5 of the 6 major topics (material availability was not corroborated) and 19 of the 32 underlying topics (see: Table 8).

Unique to this research was how civil servants discussed benefits of WMC that could be derived not only by municipalities but other stakeholders. This includes the motivation to engage in WMC stemming from a desire to support Finnish WMC industries, and the desire to support the development of 4th generation wood forest sector products. The desire to use WMC as a disruptive solution to boost quality construction in the housing market was also a unique motivator that emerged from this research. This statement directly contrasts with Riala & Ilola's (2014) description of a Finnish real estate actor's belief that WMC quality was suffering because of the scattered nature of the WMC industry value chain. These variances may be due to the limited inclusion of public sector opinions in

previous WMC attitude research, as Gosselin et al. (2017) noted that opinions on WMC vary according to role.

Table 7 – Meta-analysis of topics that motivate the use of WMC, as described by Gosselin et al. (2017). Topics are compared to results from this study. An X indicates that the topic has been mentioned by civil servants interviewed in this study.

Gosselin et al. (2017)	**Motivations for WMC Adoption**	Mentioned in Study?
Sustainable	1. Woods positive environmental performance	X
	2. Carbon sequestration	X
	3. Energy efficiency	
	4. Thermal insulation properties of wood	
	5. Lower heating costs in wood structures	
Technical aspects	1. Performance in fire	X
	2. Acoustic and insulation performance	X
	3. Good mechanical/physical properties	
	4. Ease of working with material	
	5. Hygrothermal performance	X
	6. Durability	
	7. Stability	
	8. Lightness	X
Cost reduction	1. Material, construction, and maintenance costs	Only material
	2. Building erection speed	X
Building erection speed	1. Ease of installation	X
	2. Construction speed	X
	3. Simplicity	
	4. Flexibility	
	5. Lightness	X
Aesthetics	1. Warm character	X
	2. Inviting	X
	3. Comfortable	
	4. Attractive	X
	5. Aesthetics	X
	6. Interesting	
	7. Enjoyable by occupants	X
	8. Welfare	
	9. Health effects	X
	10. Natural design	
	11. Visible beauty	X
	12. Friendly feeling	X

Gosselin et al. (2017) discerned that limited stakeholder interactions was a barrier in non-residential WMC adoption. But civil servants in this study discussed limited stakeholder interactions regarding residential WMC, particularly with end users. This was exemplified by the case of the city planner who criticized real estate agents and developers relying on "narrow" end user market-sales information to push planning and development (of usually BAU projects). This misinformation can be partially attributed to poor stakeholder interactions.

Table 8- Meta-analysis of topics that create barriers in the use of WMC, as described by Gosselin et al. (2017). Topics are compared to results from this study. An X indicates that the topic has been mentioned by civil servants interviewed in this study.

Gosselin et al. (2017)	Barriers for Adoption	Mentioned in Study?
Building Codes	1. Fire safety regulations	X
	2. Misinformed fire risk perception	X
	3. Lack of regulatory knowledge related to wood beam calculations	
Lack of Expertise	1. Lack of knowledge transferred to industry	X
	2. Lack of information	X
	3. Lack of support for technical aspects	
	4. Lack of experience/knowledge/skill using wood	X
Costs	1. Capital	
	2. Material	
	3. Construction	X
	4. Long-term maintenance	X
	5. Risk aversion of industry	X
	6. Resale value fears	X
	7. Lack of skilled workers may affect cost	X
	8. Insurance and fire sprinkler cost	X
Technical Aspects and Material Durability	1. Wood acoustics	X
	2. Security feelings	X
	3. Wood stability and shrinkage	
	4. Humidity	
	5. Stiffness/strength	
	6. Quality is lesser	
	7. Technical defects in materials	
	8. Protection against natural disasters/pest/rot	
Culture of the Industry	1. Conservative attitude of sector	X
	2. Lack of openness	
	3. Prefer established norms	X
	4. Lack of standardization	X
	5. Fragmentation of industry	X
	6. Lack of stakeholder interaction (non-residential projects)	X
	7. Lack of construction-oriented solutions	
	8. Prejudices for wood as it typically used in social housing	
	9. Need for changes in culture, policy, organizations, and behavior	X
Material Availability	1. Poor availability of engineered wood products	

Along the same line, civil servants also mentioned that Finnish citizens do not receive WMC consumers housing information. Yet civil servants also believe consumer choice is a driver for altering housing market trends. One might ask how end users can demand WMC construction, if civil servants also admit there is both a limited effort to provide consumers with awareness about the salient qualities of WMC, and a limited number of WMC projects on the market for them to gain exposure to. It could be that consumer

demand will not affect housing development until these aspects are addressed. Moreso, Riala & Ilola (2014) also speculated on the weak role of end user's capacity to shift market trends given that private developers and municipality developers regarded end user preference for materials to be low. Further research into consumer demands capacity to shift residential housing development planning is needed. A comparative study between Finland and a Nordic country who has normalized WMC (e.g. Sweden) might be a powerful tool for evaluating whether end users can leverage development planning, or whether consumer demand has served as a meaningful conduit for change in modern WMC development trends.

While the question of how consumers can affect WMC housing development in Finland should be investigated further, it is equally important to determine whether civil servants see they have a role or responsibility to address end user housing needs and to then incorporate aspects of material preference into their planning assessments. In their research, Riala & Ilola (2014) mentioned how infrequently builders (both municipal and private) included end user involvement in the design process of buildings. In this research, civil servants admitted their municipalities rarely collected information on end user desires, and that the *OAS* process was not suitable for eliciting much beyond negative feedback from residents.

But are the incorporation of end user desires by promoting the salient lifestyle aspects of WMC a role which municipalities should help fulfil, or should these mechanisms be left up to the private industries and other actors? Toppinen et al. (2018) discusses that the public sector's use of WMC to promote social equity may strengthen the WMC image, but ultimately companies must shift their business models to integrate the salient aspects that offer value to end users by communicating with these stakeholders. Consequently, should municipalities strive to push new lifestyle aspects or should companies?

Based on this study some other suggestions to addressing barriers in the normalization of WMC may be offered. First, there is a chicken-egg debate that needs solving: The cyclical paradox between limited actors resulting in limited projects and high cost, and vice versa (see: Figure 5, Section 0). It would be prudent to determine if this paradox is indeed real,

and if so, to determine at which of these points the persistence of a weak WMC industry need to be addressed. Should high cost be addressed with appropriate financing schemes or should weak actors be supported with more development projects? Both are suggestions mentioned by civil servants as policy measures they perceive to be lacking at the local and state level, yet one may prove more useful than another.

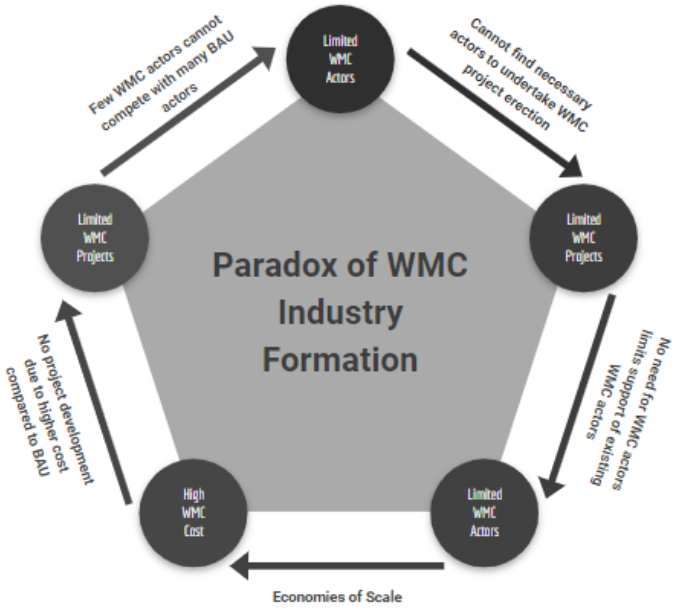

Figure 5- Paradox of WMC. According to various opinions, the cost, limited actors, and limited project implementation all result in one another. This forms a paradox in the WMC industry, but is this paradox real or perceived? (see: section 5.1.4, a weak WMC sector creates project risk).

The valuation of these hindrances may be particularly useful when attempting to determine which points in the paradox are the most central. A large survey study where civil servants place a value on the degree to which these barriers impede WMC implementation may be a means to develop a tool that guides future action plans. The survey would also help settle whether this WMC paradox is indeed real. Furthermore, due to the small sample size of participants in this study, there is no room to draw inferences regarding whether background variables shape any of the emergent subcategories (e.g. does municipality size play a role in shaping values). A statistical analysis would be useful for measuring relationships between such variables.

The last challenge which remains to be solved is civil servants lack of access to WMC information. The information obtained in this study would have been robust enough to begin delving into the relationship between municipality communication with stakeholders, and whether this affects how WMC information is transferred. Unfortunately, it was outside of the scope of this paper to address these topics. This might be a critical avenue of research given that the lack of access to WMC information is a recurrently cited barrier to WMC, and one that is neglected in studies. More pragmatic and tangible research based tools are needed to tackle this issue.

With this being said, it was also noticed by this author when attempting to access information online about WMC trends in Finland that a more transparent and centralized data monitoring system between municipality administrative services could prove useful for future city development and planning. This is especially feasible considering that municipality town planning procedures provide a variety of public data related to housing and construction trends in Finland on a yearly basis. However, this information can be convoluted to access on municipality webpages, and is too scattered to access with ease. Likewise, statistics on WMC are currently gathered by PuuInfo—a shared platform for wood product sector companies to network, exchange marketing practices, and production support—but they are not provided by the Official Statistic of Finland. This too is interesting given the states interest to support WMC.

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Appendix A. Questionnaire

*WMC = Wooden Multistory Construction, meaning 2 floors or more, with either wood frames or hybrid wood elements and materials

Frame 1. Municipality attitudes towards urban residential WMC* projects.

4. **What is the vision and strategy of the city in terms of development and housing? Is there a formal strategy? What is the role of urban residential WMC in this vision?**

5. **What do you as an individual see as the advantages and disadvantage of using wood materials in WMC? Have you ever worked with a WMC project, and if so how?**

6. **Does the municipality have formal criteria related to the living environments in homes? If so, do they assess the homes criteria post-construction?**

Frame 2. Actors involved in urban residential WMC.

7. **What actors weigh in on the decisions for or against using wood as a material in urban residential WMC? What channels of communication exist between the municipalities and these actors?**

8. **How do end user wants and needs affect urban residential WMC in the city? How does the city communicate with the end users about their wants and needs?**

9. **How does communication takes place between the municipality and builders throughout the WMC project and after the WMC project is completed?**

Frame 3. Contextual influences that impact urban residential WMC adoption.

10. **What processes exist for gathering new information on design and building technology about WMC? How is this information communicated throughout the municipality?**

11. **Are there any other issues which you find to be important that have not been discussed?**

Appendix B. Coding Framework

1.0 WMC Attitudes
- 1.1 Contributes to WMC Projects
  - 1.1.1 Supports Sustainable Development
  - 1.1.2 Climate and Environment
  - 1.1.3 Promotes New Business
  - 1.1.4 Supports Local Industries
  - 1.1.5 Branding and Marketing Opportunities
  - 1.1.6 New Construction Opportunities
  - 1.1.7 Price Competitive Aspects
  - 1.1.8 Safety (General)
  - 1.1.9 Increased Building Lifecycle
  - 1.1.10 Built Environment
  - 1.1.11 Living Environment
  - 1.1.12 Construction/Renovation Ease
  - 1.1.13 Novel and Flexible Designs
  - 1.1.14 Quality Standards
  - 1.1.15 Encourages National Forestry Sector
  - 1.1.16 Interested in WMC (General Support)
  - 1.1.17 Other
- 1.2 Hinders WMC Projects
  - 1.2.1 Financial uncertainty
  - 1.2.2 Lack of experienced designers
  - 1.2.3 Lack of experienced builders
  - 1.2.4 Slow Industry Development
  - 1.2.5 Formal Regulations Lacking or Extreme
  - 1.2.6 Accessing WMC Info is Difficult
  - 1.2.7 No Branding and Marketing Opportunities
  - 1.2.8 Lack of WMC Knowledge (General)
  - 1.2.9 Project Cost
  - 1.2.10 Materials Technical Limitations
  - 1.2.11 Building Lifecycle Uncertainties
  - 1.2.12 Safety Concerns
  - 1.2.13 Project-Builder Communication
  - 1.2.14 End user Expectation Limited
  - 1.2.15 End user Apathy
  - 1.2.16 Limited City Support
  - 1.2.17 Design/Planning Limitations
  - 1.2.18 Limited WMC Interest (General)
  - 1.2.19 Other
- 1.3 Neutral WMC Opinions

2.0 Actors
- 2.1 Participant
- 2.2 City (General)
- 2.3 City Planning Department
- 2.4 City Housing Management (Real Estate)
- 2.5 City Housing Procurement/Development
- 2.6 The State
- 2.7 Politicians (Elected)
- 2.8 City Leaders
- 2.9 Residents
- 2.10 WMC End users
- 2.11 Construction/Developer/Builders (General)
- 2.12 WMC Ecosystem
- 2.13 Concrete Industry
- 2.14 Real Estate
- 2.15 Other/Unknown

Appendix C. Coding Framework Frequency Tables

Table 9 - The frequency of phenomena categorized under the main categories 1.1. Contributes to WMC Projects and 1.2 Hinders WMC Project.

Participant Opinions - 1.1. Contributors				**Participant Opinions - 1.2 Hindrances**			
Interview	Counts			Interview	Counts		
Espoo 1	8	**All interviews**		**Espoo 1**	8	**All Interviews**	
Espoo 2	3	Average	8	**Espoo 2**	16	Average	16
Helsinki 1	17	Median	8	**Helsinki 1**	14	Median	16
Helsinki 2	10			**Helsinki 2**	21		
Rauma 1	9	(Uusikaupunki)		**Rauma 1**	17	(Uusikaupunki)	
Seinäjoki 1	7	Average	9	**Seinäjoki 1**	10	Average	17.6
Seinäjoki 2	13	Median	8	**Seinäjoki 2**	23	Median	17
Seinäjoki 3	10			**Seinäjoki 3**	15		
Turku 1	7			**Turku 1**	25		
Turku 2	2			**Turku 2**	19		
Uusikaupunki 1	3			**Uusikaupunki 1**	8		
Total	89			**Total**	176		

Table 10 - A breakdown mentioned Contributing phenomena on an interview-by-interview basis

1.1 CONTRIBUTES TO WMC PROJECTS *(Participant Opinions)*	Frequency of phenomena mentioned by interview #											
	A1	**A2**	**B1**	**B2**	**C1**	**D1**	**D2**	**D3**	**E1**	**E2**	**F1**	**Total**
1.1.1 Supports Sustainable Development	0	0	2	0	0	0	0	0	0	0	0	2
1.1.2 Climate and Environment	0	0	3	1	1	1	2	0	1	0	0	9
1.1.3 Promotes New Business Opportunities	1	0	1	0	1	0	3	1	0	0	0	7
1.1.4 Supports Local Industries	0	0	0	0	0	1	1	2	0	0	0	4
1.1.5 Branding and Marketing Opportunity	0	0	1	0	1	0	0	0	1	0	0	3
1.1.6 New Construction Opportunities	1	0	0	1	0	0	0	0	0	0	0	2
1.1.7 Price Competitive Aspects	0	0	1	1	0	1	0	1	0	0	0	4
1.1.8 Safety (General)	0	1	2	0	1	0	2	2	0	0	0	8
1.1.9 Increased Building Lifecycle	0	0	2	0	0	0	1	0	0	0	0	3
1.1.10 Built Environment	0	0	1	0	2	0	0	1	1	0	1	6
1.1.11 Living Environment	1	0	0	0	0	0	0	0	0	0	0	1
1.1.12 Construction/Renovation Ease	1	0	2	1	0	0	0	1	0	0	0	4
1.1.13 Novel and Flexible Designs	2	1	0	1	0	0	2	0	1	1	1	9
1.1.14 Quality Standards	0	0	0	2	0	1	0	0	1	0	0	4
1.1.15 Encourages National Forest Sector	0	1	0	0	1	0	0	0	0	0	0	2
1.1.16 Interested in WMC	0	0	1	1	2	0	0	0	0	1	0	5
1.1.17 Other	2	0	1	2	0	3	2	2	2	0	1	15
Total Frequency Mentions	8	3	17	10	9	7	13	10	7	2	3	89

Table 11 - Table illustrating the number of mentioned phenomena for each 1.2 Hinders WMC Projects subcategory, on an interview-by-interview basis for the case of civil servants own opinions. Totals for each subcategory are reported on the rightmost column, total

1.2 HINDERS WMC PROJECTS *(Participant Opinions)*	Frequency of phenomena mentioned by interview #											
	A1	**A2**	**B1**	**B2**	**C1**	**D1**	**D2**	**D3**	**E1**	**E2**	**F1**	**Total**
1.2.1 Financial uncertainty	0	1	0	1	0	2	1	0	1	0	0	6
1.2.2 Lack of experienced designers	0	1	0	1	0	1	0	1	0	0	0	4
1.2.3 Lack of experienced builders	0	1	1	3	1	0	0	1	0	1	0	8
1.2.4 Limited Interest (General)	0	0	0	0	0	0	0	0	0	0	0	0
1.2.5 Formal Regulations Lacking	1	1	1	2	5	1	2	2	3	3	1	22
1.2.6 Difficulty Accessing WMC Info	0	2	3	1	1	0	2	2	5	3	2	21
1.2.7 No Branding/Marketing Opportunities	0	0	0	0	0	0	0	0	0	0	0	0
1.2.8 Lack of WMC Knowledge (General)	3	0	2	0	0	2	4	1	0	0	0	12
1.2.9 Cost	0	2	2	4	0	0	1	3	0	0	1	13
1.2.10 Materials Technical Limitations	0	1	1	3	0	0	1	0	1	0	1	8
1.2.11 Building Lifecycle Uncertainties	0	1	0	0	0	0	1	1	0	0	0	3
1.2.12 Safety Concerns	0	1	0	0	1	0	0	0	0	0	0	2
1.2.13 Project-Builder Communication	1	1	0	2	0	0	2	1	2	3	0	12
1.2.14 End user Expectations Limited	1	2	1	0	2	0	5	0	4	2	0	17
1.2.15 End user Apathy	0	1	1	0	2	0	0	3	2	0	0	9
1.2.16 Limited City Support	1	0	2	0	0	0	0	0	0	3	1	7
1.2.17 Design/Planning Limitations	0	0	0	1	2	3	0	0	1	0	1	8
1.2.18 Slow Industry Development	0	1	0	2	2	1	2	0	6	4	1	19
1.2.19 Other	1	0	0	1	1	0	2	0	0	0	0	5
Total Mention by interview #	8	16	14	21	17	10	23	15	25	19	8	176

Table 12 – Municipality opinon frequencies, broken down by each actor sub-category making up this larger municipality category group

Municipality Opinions	City (General)	City Planning Department	City Housing Management (Real Estate)	City Housing Procurement (Development)	Local Politicians	City Leaders	City (Total)
1.1.1 Supports Sustainable Development	0	0	0	0	0	0	0
1.1.2 Climate and Environment	2	3	1	0	0	1	7
1.1.3 Promotes Business Opportunities	5	0	0	0	0	1	6
1.1.4 Supports Local Industries	6	0	0	0	0	0	6
1.1.5 Branding and Marketing Opportunity	11	1	0	0	1	0	13
1.1.6 New Construction Opportunities	0	0	0	0	0	0	0
1.1.7 Price Competitive Aspects	0	0	0	0	0	0	0
1.1.8 Safety (General)	0	0	0	0	0	0	0
1.1.9 Increased Building Lifecycle	0	0	0	0	0	0	0
1.1.10 Built Environment	0	1	0	0	0	0	1
1.1.11 Living Environment	0	0	0	0	0	0	0
1.1.12 Construction/Renovation Ease	0	0	0	0	0	0	0
1.1.13 Novel and Flexible Designs	1	0	0	0	0	1	2
1.1.14 Quality Standards	3	1	0	0	0	0	4
1.1.15 Encourages National Forest Sector	1	0	0	0	0	0	1
1.1.16 Interested in WMC	4	3	1	1	6	3	18
1.1.17 Other	3	2	0	0	0	0	5
Total Contributing Phenomena	36	11	2	1	7	6	63
1.2.1 Financial uncertainty	2	0	0	0	0	0	2
1.2.2 Lack experienced designers/planners	0	1	0	0	0	0	1
1.2.3 Lack experienced builders	1	0	0	0	0	0	1
1.2.4 Limited Interest in WMC	0	3	2	0	1	0	6
1.2.5 Formal Regulations	2	0	0	0	0	0	2
1.2.6 Accessing WMC Info is Difficult	0	0	0	0	0	0	0
1.2.7 No Branding/Marketing Opportunities	4	0	0	1	0	1	6
1.2.8 Lack of WMC Knowledge	3	0	0	1	0	0	4
1.2.9 Cost	2	1	0	0	0	0	3
1.2.10 Materials Technical Limitations	0	0	0	0	0	0	0
1.2.11 Building Lifecycle Uncertainties	0	0	0	0	0	0	0
1.2.12 Safety Concerns	1	0	0	0	0	0	1
1.2.13 Project-Builder Communication	0	1	0	0	0	0	1
1.2.14 End user Expectation Limited	7	0	0	0	0	0	7
1.2.15 End user Apathy?	0	0	0	0	0	0	0
1.2.16 Limited City Support	0	0	0	0	0	0	0
1.2.17 Design/Planning Limitations	0	0	0	0	0	0	0
1.2.18 Slow Industry Development	0	0	1	0	0	0	1
1.2.19 Other	2	0	0	2	0	0	4
Total Hindering Phenomena	24	6	3	4	1	1	39
1.3 NEUTRAL	1	0	1	0	0	0	2

Table 13 – Citizen opinon frequencies, broken down by each actor sub-category making up this larger group

Attitudes Held by Citizens (Residents and End users)	Residents	WMC End users	Total
1.1.1 Supports Sustainable Development	0	0	0
1.1.2 Climate and Environment	1	0	1
1.1.3 Promotes Business Opportunities	0	0	0
1.1.4 Supports Local Industries	0	0	0
1.1.5 Branding and Marketing Opportunity	0	0	0
1.1.6 New Construction Opportunities	0	0	0
1.1.7 Price Competitive Aspects	4	0	4
1.1.8 Safety (General)	4	0	4
1.1.9 Increased Building Lifecycle	0	0	0
1.1.10 Built Environment	4	0	4
1.1.11 Living Environment	4	4	8
1.1.12 Construction/Renovation Ease	0	0	0
1.1.13 Novel and Flexible Designs	0	0	0
1.1.14 Quality Standards	0	0	0
1.1.15 Encourages National Forest Sector	1	0	1
1.1.16 Interested in WMC	5	0	5
1.1.17 Other	0	0	0
Total Contributing Phenomena	23	4	27
1.2.1 Financial uncertainty	1	0	1
1.2.2 Lack experienced designers/planners	0	0	0
1.2.3 Lack experienced builders	0	0	0
1.2.4 Limited Interest in WMC	5	0	5
1.2.5 Formal Regulations	0	0	0
1.2.6 Accessing WMC Info is Difficult	0	0	0
1.2.7 No Branding/Marketing Opportunities	0	0	0
1.2.8 Lack of WMC Knowledge	4	0	4
1.2.9 Cost	4	0	4
1.2.10 Materials Technical Limitations	0	0	0
1.2.11 Building Lifecycle Uncertainties	1	0	1
1.2.12 Safety Concerns	2	0	2
1.2.13 Project-Builder Communication	0	0	0
1.2.14 End user Expectation Limited	0	0	0
1.2.15 End user Apathy?	0	0	0
1.2.16 Limited City Support	0	0	0
1.2.17 Design/Planning Limitations	0	0	0
1.2.18 Slow Industry Development	0	0	0
1.2.19 Other	3	1	4
Total Hindering Phenomena	20	1	21
1.3 NEUTRAL	1	0	1

Table 14 – Private company frequencies, broken down by each actor sub-category making up this larger group

Attitudes Held by Private Companies	Developers (General)	WMC Industry	Concrete Industry
1.1.1 Supports Sustainable Development	0	0	0
1.1.2 Climate and Environment	0	0	0
1.1.3 Promotes Business Opportunities	3	1	0
1.1.4 Supports Local Industries	0	0	0
1.1.5 Branding and Marketing Opportunity	1	0	0
1.1.6 New Construction Opportunities	0	0	0
1.1.7 Price Competitive Aspects	2	0	0
1.1.8 Safety (General)	1	0	0
1.1.9 Increased Building Lifecycle	0	0	0
1.1.10 Built Environment	0	0	0
1.1.11 Living Environment	0	0	0
1.1.12 Construction/Renovation Ease	2	0	0
1.1.13 Novel and Flexible Designs	0	0	0
1.1.14 Quality Standards	0	0	0
1.1.15 Encourages National Forest Sector	0	0	0
1.1.16 Interested in WMC	5	2	0
1.1.17 Other	1	0	0
Total Contributing Phenomena	15	3	0
1.2.1 Financial uncertainty	9	1	0
1.2.2 Lack experienced designers/planners	0	0	0
1.2.3 Lack experienced builders	5	0	0
1.2.4 Limited Interest in WMC	9	0	2
1.2.5 Formal Regulations	0	0	0
1.2.6 Accessing WMC Info is Difficult	1	0	0
1.2.7 No Branding/Marketing Opportunities	2	0	0
1.2.8 Lack of WMC Knowledge	0	0	0
1.2.9 Cost	9	0	0
1.2.10 Materials Technical Limitations	1	2	0
1.2.11 Building Lifecycle Uncertainties	2	0	0
1.2.12 Safety Concerns	1	0	0
1.2.13 Project-Builder Communication	0	0	0
1.2.14 End user Expectation Limited	0	0	0
1.2.15 End user Apathy?	0	0	0
1.2.16 Limited City Support	0	0	0
1.2.17 Design/Planning Limitations	1	0	0
1.2.18 Slow Industry Development	2	0	0
1.2.19 Other	2	0	0
Total Hindering Phenomena	44	3	2
1.3 NEUTRAL	1		

Appendix D. Exemplary Zoning Plans

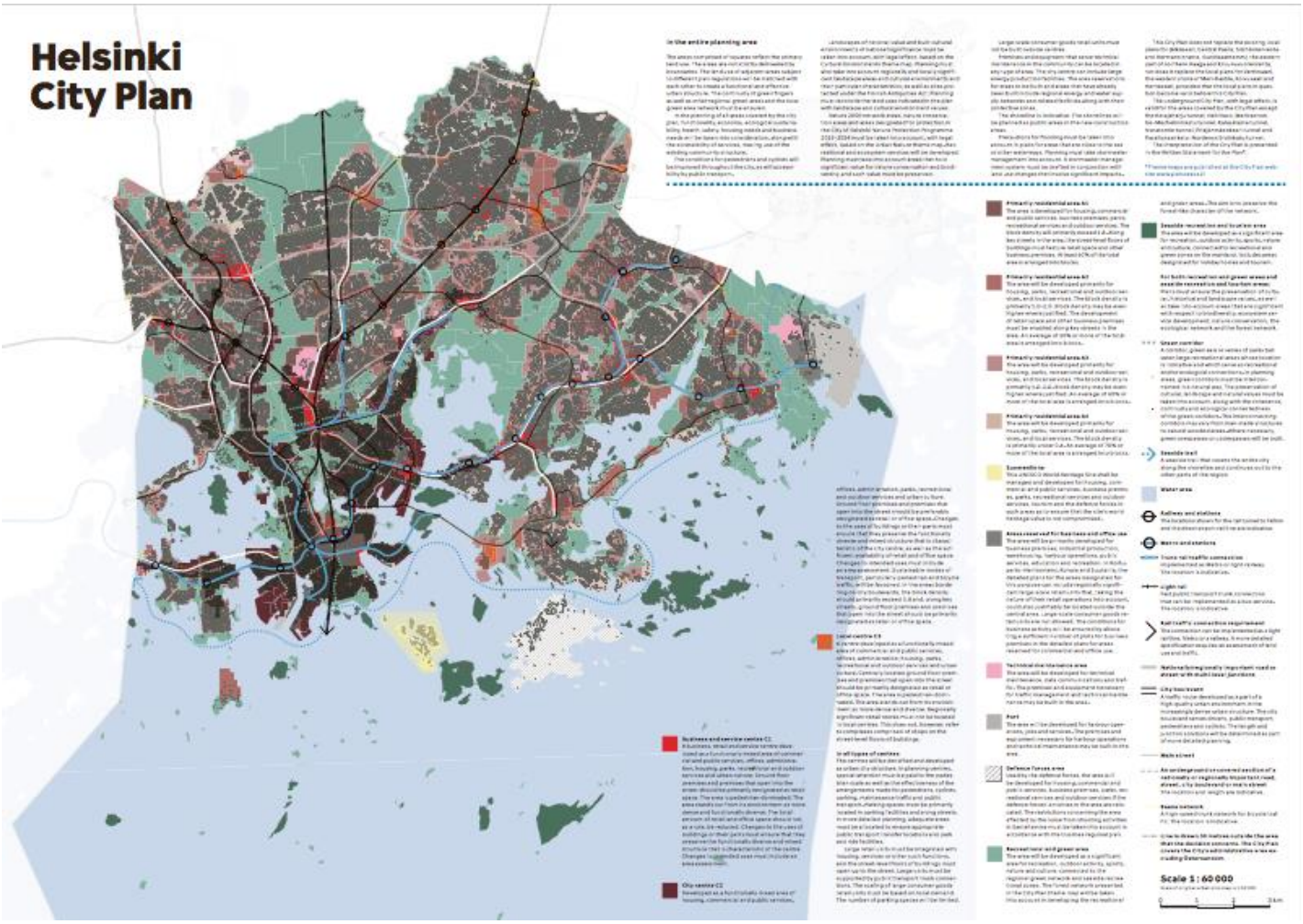

Figure 6- Helsinki City Plan, Helsinki's master plan with charted areas, and regulations for charted areas written on the ledger of the map. It is important to note that at this time this master plan is currently undergoing a process of evaluation by the highest administrative court prior to its legal ratification and coming into effect. This plan is not yet legally binding (Image from: City of Helsinki 2016).

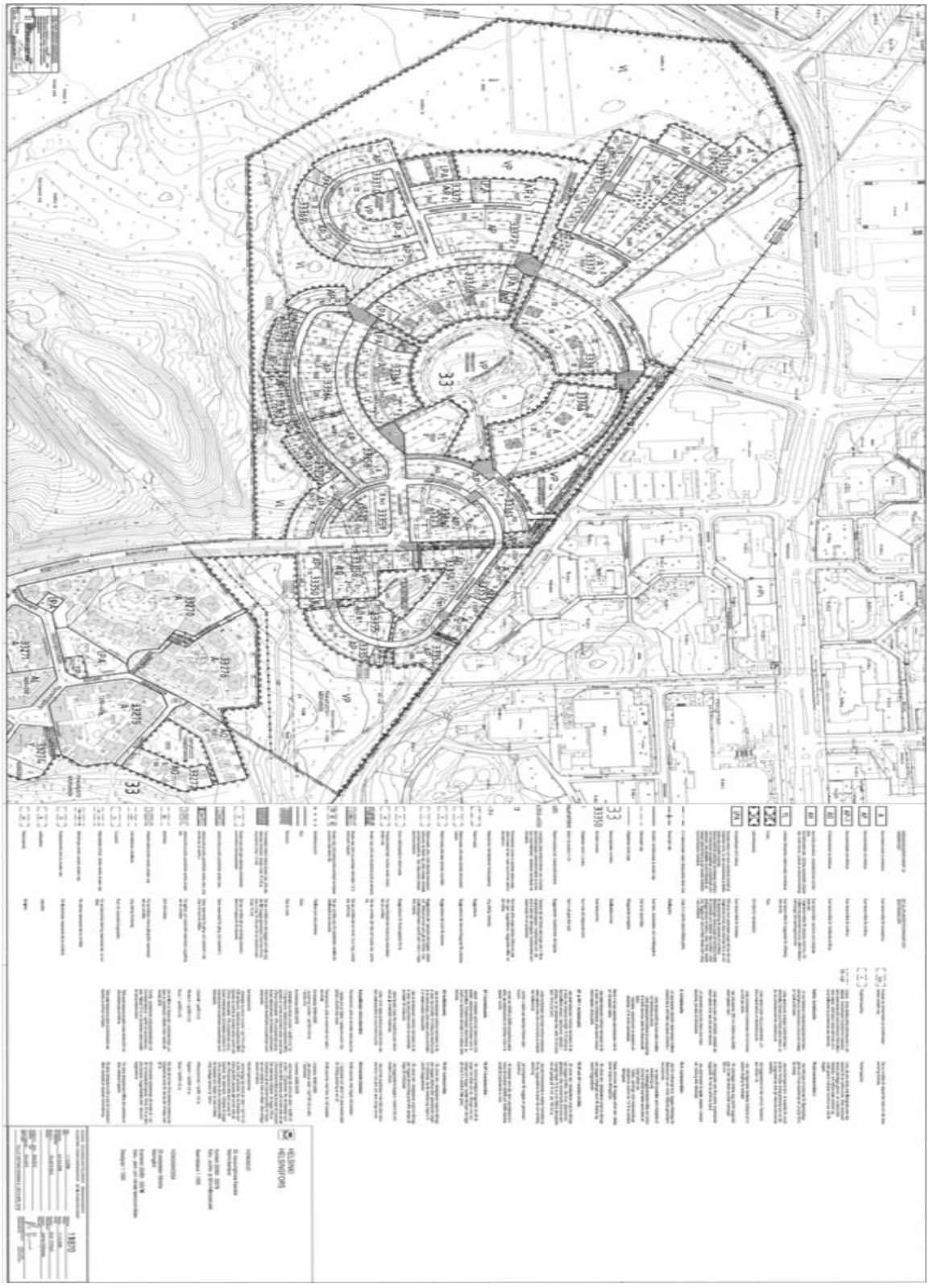

Figure 7- The local detailed plan for Honkasua (11870). Here regulations of the expectations of the local neighborhood are written on the margins to the right of the plan.